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VOL. CXLIII.—No. 3723] LONDON: FRIDAY EVENING, MAY 20, 1927 [PRICE ONE SHILLING BY INLAND POST 1s. 3d.

PUBLIC NOTICES

CRANE.

The Commissioners of His Majesty's Works, &c., are prepared to receive TENDERS before 11 a.m. on Friday, 3rd June, 1927, for the SUPPLY and ERECTION of a 5-TON GANTRY CRANE at the Forest Products Research Laboratory, Princes Risborough, Bucks. Drawings, specification, and a copy of the conditions and form of contract and forms for Tender may be obtained from the CONTRACTS BRANCH, H.M. Office of Works, King Charles-street, London, S.W. 1, on payment of One Guinea. (Cheques payable to the Commissioners of H.M. Works, &c.) The sums so paid will be returned to those persons who send in Tenders in conformity with the conditions. 5509

TO BUILDERS.

The Commissioners of His Majesty's Works, &c., are prepared to receive TENDERS before 11 a.m. on Thursday, 2nd June, 1927, for ACCELERATED LOW-PRESSURE HOT WATER HEATING at Middlesbrough Head Post Office.

Drawings, specification, a copy of the conditions and form of contract, bills of quantities and forms for Tender may be obtained from the CONTRACTS BRANCH, H.M. Office of Works, King Charles-street, London, S.W. 1, on payment of One Guinea. (Cheques payable to the Commissioners of H.M. Works, &c.) The sums so paid will be returned to those persons who send in Tenders in conformity with the conditions. 5486

The Director-General, India Store Department, Branch No. 15, Belvedere-road, Lambeth, S.E. 1, invites TENDERS for :—

1150 PAIRS DISC WHEELS AND AXLES.

Tenders due on the 2nd June, 1927.

Specifications and forms of Tender obtainable from the above at a fee of 5s. per set, which will not be returned. 5532

Assistant Engineers (13) REQUIRED for the PUBLIC WORKS DEPARTMENT of the FEDERATED MALAY STATES for four years' service, after which subject to satisfactory service, the officers appointed will be eligible for confirmation in the permanent and pensionable establishment. It is probable that the number of permanent appointments will be sufficient for those officers whose services have been entirely satisfactory, but no absolute guarantee can be given. If at the end of four years' service, an officer's services have been entirely satisfactory and he is not offered or declines further employment he will be paid a bonus of Dols. 2850. Salary Dols. 400 a month, rising to Dols. 800 by annual increments of Dols. 25, plus a temporary non-pensionable allowance of 10 per cent. for bachelors and 20 per cent. for married men. The exchange value of the dollar in sterling is at present fixed by the Government at 2s. 4d., but its purchasing power in Malaya is considerably less than that of 2s. 4d. in the United Kingdom. No Income Tax at present imposed by the Federated Malay States Government. Free passages provided. Candidates, age 23 to 26, preferably unmarried, must have received a good theoretical training, preferably at a University or College recognised by the Institution of Civil Engineers and possess a Civil Engineering degree or obtained such other diploma or distinction in Engineering as the Secretary of State may decide in any particular case or have completed articles with a Civil Engineer of good standing, and have passed the examination for Associate Membership of the Institution of Civil Engineers. In addition, candidates must have had at least one year's practical experience of civil engineering under a qualified civil engineer. Apply at once by letter, giving brief details of qualifications and experience, and stating age, and whether married or single, to the CROWN AGENTS FOR THE COLONIES, 4, Millbank, Westminster, S.W. 1, quoting clearly at the head of application M/15,224. 5 539

Civil Service Commission. FORTHCOMING EXAMINATION. PROBATIONARY ASSISTANT ENGINEERS in the Engineering Department of the Post Office (20-23, with extension in certain cases). Regulations and particulars are obtainable from the SECRETARY, Civil Service Commission, Burlington-gardens, London, W. 1, together with the form on which application must be made. The latest date for the receipt of application forms is 14th July. 5243

Civil Service Commission. FORTHCOMING EXAMINATION. PROBATIONARY INSPECTORS in the Engineering Department of the Post Office (17-20, with extension for service in H.M. Forces).—Regulations and particulars are obtainable from the SECRETARY, Civil Service Commission, Burlington-gardens, London, W. 1, together with the form on which application must be made. The latest date for the receipt of application forms is 28th July. 5168

Manchester Municipal College OF TECHNOLOGY.

PRINCIPAL :
B. MOUAT JONES, D.S.O., M.A. (Oxon).

UNIVERSITY OF MANCHESTER
(FACULTY OF TECHNOLOGY).
DEGREE COURSES IN TECHNOLOGY.

The Prospectus gives particulars of the Courses leading to the Manchester University Degrees (B.Sc. Tech., M.Sc. Tech., and Ph. D.) in the Faculty of Technology, in the following Departments :—

MECHANICAL ENGINEERING (Prof. Dempster Smith, M.B.E., M.Sc. Tech.).
ELECTRICAL ENGINEERING (Prof. Miles Walker, M.A., D.Sc.).
MUNICIPAL AND SANITARY ENGINEERING (G. S. Coleman, D.Sc.).
CHEMICAL TECHNOLOGY, including General Chemical Technology, Chemistry of Textiles (Bleaching, Dyeing, Printing and Finishing), Paper Manufacture, Metallurgy and Assaying, Chemical Technology of Brewing, Electro-Chemistry, Photography, Colouring Matters, Foodstuffs and Fuels (Prof. F. L. Pyman, D.Sc., F.R.S.).
TEXTILE TECHNOLOGY (Prof. W. E. Morton, M.Sc. Tech.).

Prospectus will be forwarded free on application to the REGISTRAR, College of Technology, Manchester. 5409

The Engineer

PRINCIPAL CONTENTS OF THIS ISSUE.
ARRANGED FOR CARD INDEXING.

A Large Cable-Armouring Machine. THE ENGINEER, 20-5-27.

20,000 K.W. Turbo-Alternator—No. II. THE ENGINEER, 20-5-27.

Report on London Waters. (SIR A. C. HOUSTON.) THE ENGINEER, 20-5-27.

1000 B.H.P. Airless-Injection Oil Engine: Tests. THE ENGINEER, 20-5-27.

The Iron and Steel Institute—No. II. THE ENGINEER, 20-5-27.

Armament of Capital Ships. THE ENGINEER, 20-5-27.

Resuscitating a Somerset Quarry. THE ENGINEER, 20-5-27.

A Large Mine Fan. THE ENGINEER, 20-5-27.

Voltage Regulating Equipment for Transmission Lines. THE ENGINEER, 20-5-27.

PUBLIC NOTICES

Battersea Polytechnic. LONDON, S.W. 11.

The Governing Body invite APPLICATIONS for the POSITION of PRINCIPAL of the POLYTECHNIC, owing to the resignation of Dr. R. H. Pickard, F.R.S., upon appointment as Director of the British Cotton Industry Research Association.

Salary, £1250-£50-£1500.

Applications to be made not later than June 13th.

Full particulars obtainable on application to the CLERK TO THE GOVERNING BODY. 5516

Crystal Palace School of Practical Engineering. Founded 1872.

MECHANICAL AND CIVIL ENGINEERING DIVISIONS.

PRESIDENT : J. W. WILSON, M.I.C.E., M.I.M.E.
PRINCIPAL : MAURICE WILSON, M.I.C.E.
Assisted by Staff of Lecturers and Instructors.
Thorough, up-to-date Practical and Theoretical Instruction. Course completed in 2 years.
Students admitted at beginning of any term. 5189

PATENTS AND DESIGNS ACTS, 1907 AND 1919.

Notice is Hereby Given that ALFRED ERNEST WHITE, A.I. Mech. E., Fellow of the Chartered Institute of Patent Agents, a subject of the King of Great Britain, of White, Langner, Stevens and Parry, Chambers, 88-90, Chancery-lane, London, Chartered Patent Agents, SEEKS LEAVE to AMEND the SPECIFICATION of the APPLICATION for LETTERS PATENT No. 261,085, for an invention entitled "Improvements in or relating to Cutting and like Machine Tools."

Particulars of the proposed amendments are set forth in the Illustrated Official Journal of the 11th May, 1927.

Any person, or persons, may give Notice of Opposition to the amendment by leaving Patents Form No. 19 at the Patent Office, 25, Southampton-buildings, London, W.C. 2, within one calendar month from the date of said Journal.

W. S. JARRATT,
Comptroller-General.
5487

PUBLIC NOTICES

City and County of Newcastle-upon-Tyne EDUCATION COMMITTEE.

RUTHERFORD TECHNICAL COLLEGE.

Principal : R. C. EDGAR, Esq., D.Sc., F.I.C.

APPLICATIONS are INVITED from suitably qualified persons for APPOINTMENT, to date from 1st September, 1927, as HEAD of MECHANICAL ENGINEERING DEPARTMENT. Salary scale, minimum £500 per annum, by annual increments of £20, to a maximum of £600 per annum.

Form of application and further particulars will be sent on receipt of stamped addressed foolscap envelope.

Completed applications must be returned to me at the Education Office, Northumberland-road, Newcastle-upon-Tyne, not later than 3rd June, 1927.

THOS. WALLING,
Director of Education.
5515

B.B. & C.I. Railway Company. The Directors are prepared to receive up to Noon on Wednesday, 8th June, TENDERS for the SUPPLY of :—

1. SCREW COUPLINGS.
2. LAMINATED and ELLIPTICAL SPRINGS.
3. CRANK and STRAIGHT AXLES for LOCOS.
4. HELICAL and VOLUTE SPRINGS.
5. STEEL BOILER TUBES, FLUE TUBES and STEAM PIPES.
6. TYRES for CARRIAGES.
7. STEEL MATERIAL (M.S. PLATES).

Tenders must be made on forms, copies of which, with specification, can be obtained at these offices on payment of £1 each for Nos. 1 and 2 and 10s. each for Nos. 3 to 7 (which will not be returned).

The Directors do not bind themselves to accept the lowest or any Tenders.

S. G. S. YOUNG,
Secretary.

Offices : 91, Petty France, Westminster, S.W. 1.
16th May, 1927. 5507

Bengal-Nagpur Railway Company, LIMITED.

The Directors are prepared to receive TENDERS for : 11 SPANS, GIRDER BRIDGES (100ft. Span).

Specification and form of Tender can be obtained at the Company's Offices, 132, Gresham House, Old Broad-street London, E.C. 2, on or after 19th May, 1927.

A fee of 20s. will be charged for the specification, which is now returnable.

Tenders must be submitted not later than Noon on Tuesday, 31st May, 1927.

The Directors do not bind themselves to accept the lowest of any Tender, and reserve to themselves the right of reducing or dividing the order.

By Order of the Board,
R. C. VOLKERS,
Secretary.
19th May, 1927. 5550

PUBLIC NOTICES

Albania. TENDERS are INVITED by the Albanian Government for the CONSTRUCTION of an IRON BRIDGE over the River Buna, at Scutari.

For particulars of Tenders, apply to the ALBANIAN LEGATION, 137, Beaufort-street, S.W. 3.

The latest date for the deposit of Tenders is June 1st, 1927. 5542

City and County of Kingston-upon-Hull.

The Electricity Committee of the Hull Corporation invite TENDERS for

CONTRACT 116,

which comprises the whole of the IRON and STEEL WORK in connection with the CONSTRUCTION of an ELLIPTICAL STEEL COAL BUNKER AND CONVEYOR HOUSING.

Tender form, general conditions, and specification are obtainable only on application direct to the undersigned. Such application must be accompanied by a cheque (made payable to the "City Treasurer, Guildhall, Hull") covering the amount of the deposit, viz., One Guinea for each first copy required.

First copy deposits are returnable on receipt of a bona fide Tender.

The Corporation does not bind itself to accept the lowest or any Tender.

Tenders, addressed "Chairman, Electricity Committee, Town Clerk's Office, Guildhall, Hull," and endorsed "Steel Coal Bunker," are to be delivered by Noon on Thursday, 16th June, 1927.

H. BELL, M.I.E.E.,
City Electrical Engineer and Manager.
Electricity Works,
Sculcoates, Hull,
May, 1927. 5514

Limerick Harbour Commissioners. LIMERICK HARBOUR. CONSTRUCTION OF NEW DOCK.

The Limerick Harbour Commissioners invite TENDERS for the CONSTRUCTION of a NEW DOCK at Limerick, comprising about 6¾ acres in extent, including Excavation, Dock Walls, New Entrance and Dock Gates, Entrance Jetties, Dredging and other Works, as provided for in the plans, specification and conditions of contract, which may be inspected at the office of Mr. T. P. O'Sullivan, B.E., Harbour Engineer, Limerick, or the office of the Consulting Engineer, Mr. P. H. McCarthy, M.A., B.A.I., M. Inst. C.E.I., 26, Lower Leeson-street, Dublin, during the usual office hours.

Forms of Tender, conditions of contract, specification, and schedule of quantities may be obtained from the undersigned on payment of a deposit of £20, which will be returned on receipt of a bona fide Tender, together with all the aforesaid documents.

Tenders, enclosed in sealed envelopes, addressed to the undersigned and marked "Tender for New Dock," must be delivered at the offices of the Commissioners not later than Ten o'clock a.m. on 20th day of July, 1927.

The Commissioners do not bind themselves to accept the lowest or any Tender nor will the Commissioners be responsible for any expenses incurred by persons tendering.

JOHN F. POWER,
Secretary,
Limerick Harbour Commissioners.
Limerick Harbour Commissioners' Office,
Limerick. 5492

South Indian Railway Company, LIMITED.

The Directors are prepared to receive TENDERS for the SUPPLY of :—

1. 12 LOCOMOTIVE BOILERS.
2. SPARE PARTS of LOCOMOTIVE ENGINES.
3. RAILWAY TICKETS.
4. FENCING MATERIALS.
5. GALVANISED FENCING PALES.
6. 4 WATER CRANES.

Specifications and forms of Tender will be available at the Company's Offices, 91, Petty France, Westminster, S.W. 1.

Tenders addressed to the Chairman and Directors of the South Indian Railway Company, Limited, marked "Tender for Locomotive Boilers," or as the case may be, must be left with the undersigned not later than Twelve Noon on Friday, the 3rd June, 1927, in respect of Specifications Nos. 3, 4, 5, and 6, and the 10th June, 1927, in respect of Specifications Nos. 1 and 2.

The Directors do not bind themselves to accept the lowest or any Tender.

A charge, which will not be returned, will be made of £1 for each copy of Specifications Nos. 1 and 2, of 10s. for each copy of Specifications Nos. 3 and 4, and of 5s. for each copy of Specifications Nos. 5 and 6.

Copies of the drawings may be obtained at the offices of the Company's Consulting Engineers, Messrs. Robert White and Partners, 3, Victoria-street, Westminster, S.W. 1.

A. MUIRHEAD,
Managing Director.
91, Petty France, S.W. 1,
17th May, 1927. 5531

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PUBLIC NOTICES

Parish of Bermondsey.

TO FIRE ESCAPE STAIRCASE MANUFACTURERS.

The Guardians of the Parish of Bermondsey invite TENDERS for :—

SUPPLYING and ERECTING FOUR NEW FIRE ESCAPE STAIRS and REPAIRING and PAINTING SEVEN existing FIRE ESCAPE STAIRS at the Bermondsey and Rotherhithe Hospital, Lower-road, Rotherhithe, according to specification of Messrs. Newman and Newman, Architects.

Persons desirous of tendering may obtain specifications and printed forms of Tender (which can only be received) at my office between 10 a.m. and Twelve Noon on the 23rd, 24th, 25th, and 26th May, 1927, by depositing a £5 Bank of England note.

Sealed Tenders to be delivered at my office not later than 6 p.m. on Thursday, 2nd June, 1927.

By Order,
HENRY H. REEVE,
Clerk to the Guardians.

Guardians' Offices,
283, Tooley-street, S.E. 1,
12th May, 1927. 5490

The Ipswich Dock Commission

invite TENDERS for the CONSTRUCTION of a PAIR of WOODEN LOCK GATES.—Full particulars may be obtained from the Commission's Engineers, Messrs. MILLER SON and CLARKE, 9, Thoroughfare, Ipswich. 5496

PUBLIC HEALTH ACT, 1875.

Urban District of Stevenage,

HERTFORDSHIRE.
CONTRACT NO. 2.

The Urban District Council of Stevenage, acting as the Sanitary Authority for the said district, are prepared to receive TENDERS for the CONSTRUCTION of SLUDGE LAGOONS, &c., at the Sewage Outfall Works.

Particulars and specification may be obtained at the offices of the Consulting Engineers, Messrs. Howard Humphreys and Sons, 28, Victoria-street, Westminster, or at the offices of the Surveyor to the Council on and from Monday, the 30th of May, until Saturday, the 4th of June, between the hours of 10 a.m. and 4 p.m., upon payment of a deposit of One Guinea which deposit will be returned upon receipt of a bona fide Tender which is not subsequently withdrawn by the contractor.

The successful tenderer will be required to execute a contract deed, the draft of which is incorporated with the specification.

Tenders must be on the official form, each Tender in a sealed envelope marked "Tender for Sludge Lagoons." Tenders must be accompanied by the general conditions and specification as issued by the Consulting Engineers.

Each Tender must be signed in the handwriting of the tenderer or his authorised agent.

The Council does not bind itself to accept the lowest or any Tender.

Tenders must reach the undersigned by 9 a.m. on Wednesday, the 15th of June, 1927.

Given under my hand the 14th day of May, 1927.
W. O. TIMES,
Clerk to the Stevenage U.D.C.

Council Offices,
Stevenage, Hertfordshire. 5493

River Rother Improvement

WORKS.
GENERAL FOREMAN.

The Commissioners for the Kent and Sussex Rother Levels will shortly REQUIRE the SERVICES of a GENERAL FOREMAN in connection with the above works. Applicants must be experienced in supervising River, Dock or Harbour Work, Pile Driving, &c.

Applications, including copies in duplicate of three recent testimonials and stating salary required, to be forwarded not later than Tuesday, May 31st, to the undersigned.

M. DU-PLAT-TAYLOR, M. Inst. C.E.,
Consulting Engineer to the Commissioners.
36, Victoria-street, Westminster,
London, S.W. 1. 5489

River Rother Improvement

WORKS.
RESIDENT ENGINEER.

The Commissioners for the Kent and Sussex Rother Levels will shortly REQUIRE the SERVICES of a RESIDENT ENGINEER in connection with the above works. Applicants must have had experience in carrying out River, Dock or Harbour Work by direct administration and must be Corporate Members of the Institution of Civil Engineers.

Applications, including copies in duplicate of three recent testimonials and stating salary required, to be forwarded not later than Tuesday, May 31st, to the undersigned.

M. DU-PLAT-TAYLOR, M. Inst. C.E.,
Consulting Engineer to the Commissioners.
36, Victoria-street, Westminster,
London, S.W. 1. 5488

Royal State Railways of Siam.

APPLICATIONS are INVITED for the POSITION of BOILERMAKER to the above Railways. Applicants must be single and have had first-class experience in the construction and repair of locomotive boilers. The engagement will be for three years in the first instance, at a salary of 400 ticals per month for the first year, 475 ticals per month for the second year, and 500 ticals per month for the third year (1 tical equal £1 approximately); £80 allowed for passage.—Apply by letter to Messrs. SANDBERG, 40, Grosvenor-gardens, S.W. 1, giving full particulars as to age, when at liberty and experience together with copies of references. 5526

SITUATIONS OPEN

COPIES OF TESTIMONIALS, NOT ORIGINALS, UNLESS SPECIFICALLY REQUESTED.

WANTED by Leading Commercial Concern in London, a first-class proved REPRESENTATIVE, about 35 years old, with good connections amongst leading shipping companies. Knowledge of engineering desirable, but not essential. Capable of representing a firm of high standing.—Address, 5494, The Engineer Office. 5494 A

WANTED, CHIEF ELECTRICIAN for Large Steel Works in Sheffield district, to Take Charge of Generation, Distribution and Maintenance under Chief Engineer.—Address, 5504, The Engineer Office. 5504 A

WANTED, TECHNICAL REPRESENTATIVE with connection among Heating, Drying and Textile Engineers and Architects in Lancashire and Yorkshire area to promote sale of Patent Air Heating Batteries of established reputation.—Reply, stating experience and qualifications, to D. F. THOMSON and CO., Ltd., 54, Victoria-street, Westminster, S.W. 1. P3159 A

DORMAN, LONG and CO., Ltd., REQUIRE for their Middlesbrough Bridge and Constructional Steel Work Department an ASSISTANT to the MANAGER thereof. Applicants not to exceed 40 years of age and must have had a sound theoretical, practical, and business training. Only such need apply.—Applications, stating age, qualifications, experience, &c., to be addressed to Box "C," Kidd's Advertising Agency, Middlesbrough. 5535 A

ENGINEER, Experienced Road Construction, for South America; fluent Spanish essential. Write fully particulars career, salary required.—Address, 5497, The Engineer Office. 5497 A

ENGINEER REQUIRED for Cement Works Abroad, age 28/35.—State fully experience erection of plant, salary required, &c. Good opening for right man.—Write, "O. P.," c/o Street's, 6, Gracechurch-street, E.C. 3. 5491 A

ENGINEER REQUIRED for Abroad, Aged 28/35, with experience Erection and Running of Cement Machinery. State fully experience and salary required.—Write to "O. P.," c/o Street's, 6, Gracechurch-street, E.C. 3. 5529 A

SITUATIONS OPEN (continued)

INDIA.—REQUIRED by British Firm of Engineers, DRAUGHTSMAN, accustomed to Roof, Bridge and Structural Steel Work, able to work out stresses and prepare designs, estimates, and detail drawings. Must be a bachelor, age 22 to 25.—Apply, stating age and particulars of experience, to Z.D. 323, c/o Deacon's Advertising Agency, Fenchurch-avenue, E.C. 3. 5508 A

PROGRESS MAN REQUIRED for Large Engineering Works, London district; must be fully experienced in Machine Shop Progress Work and able to Take Charge of Section if required.—Address, stating age, experience, and salary required, 5524, The Engineer Office. 5524 A

RATE FIXER WANTED, Used to General and Heavy Machinery. Must be first-class time and motion study man and able to demonstrate studies. Full particulars of experience and salary required.—Address, 5521, The Engineer Office. 5521 A

REFRIGERATION ENGINEER.—WANTED, Near Birmingham, smart DRAUGHTSMAN, with experience in Ammonia Compression System, who can make complete lay-outs and prepare estimates against enquiries. Permanent and progressive situation.—Address, stating age, experience, and salary required, 5520, The Engineer Office. 5520 A

REINFORCED CONCRETE DESIGNERS (TWO) REQUIRED, with specialist training.—Address applications, stating age, experience, and salary required, 5528, The Engineer Office. 5528 A

REPRESENTATIVE FOR MIDLAND AREA.

A LEADING FIRM OF
DROP FORGERS AND STAMPERS
REQUIRE A REPRESENTATIVE FOR THE MIDLANDS.

On a Salary and Expenses Basis.

Applicants must be well educated, of good address, and experienced.

Address, stating age and full particulars of past experience (in confidence), P3193, The Engineer Office. P3193 A

PLANNING and EFFICIENCY ENGINEER REQUIRED by large Motor Car Works in Birmingham district; must be fully conversant with modern Tooling Methods, Rate-setting and Laying-out of Manufacturing Operations. Experience of Jig and Tool Design an advantage. Good opportunity for suitable man. Give full particulars of education, experience and salary required.—Address, 5540, The Engineer Office. 5540 A

SALESMAN REQUIRED, Preferably Residing South of the Thames, for De Laval Centrifugal Oil Purifiers, &c. Expert salesmanship combined with engineering and technical knowledge essential. Salary and commission. Good prospects.—Address, P3155, The Engineer Office. P3155 A

SHOPS SUPERINTENDENT WANTED for General Engineering Works near Manchester, with Foundries, Light and Heavy Machine Shops, Fitting and Erecting Shops, normally employing 600/700 men, largely on heavy work. Good opening for a first-class practical man with energy, tact, and initiative. Must have knowledge of up-to-date methods and be able to obtain maximum output at lowest cost.

Address, stating age, salary, and full particulars of experience, 5446, The Engineer Office. 5446 A

WORKS MANAGER for London Shop, About 300 hands. Abilities must combine all modern machine shop practices as conjoined with usual technicalities of various estimating departments; must understand and organise labour of varied trades, strong disciplinarian, keen progress of work supervisor. State age, experiences, salary required.—Address, P3200, The Engineer Office. P3200 A

WANTED, DRAUGHTSMAN, with General Mechanical experience, for Peru. Good climate. Age 23/25, single. Board and lodging found. Preference given to one with shop training.—State qualifications, previous experience, and salary required, to Box 242, c/o Judd's, 47, Gresham-street, E.C. 2. 5513 A

WANTED, Good JUNIOR DRAUGHTSMAN, Used to Steel Structural Work, General Engineering, and Coal-handling Plant for Gasworks, for West of England.—Address, stating age, qualifications, and salary required, 5502, The Engineer Office. 5502 A

WANTED IMMEDIATELY, TWO MECHANICAL DRAUGHTSMEN, with experience in Automatic or Semi-automatic Machinery. Must have a sound knowledge of machine design. State age, qualifications, and salary required.—Address, 5525, The Engineer Office. 5525 A

WANTED, JUNIOR DRAUGHTSMAN, Accustomed to Power Station Work and Pipe Work Lay-outs. Present inclusive wages £3 3s., rising to £3 15s. (subject to adjustment in accordance with cost of living).—Write, stating age, training, and previous experience, to "J. D.," c/o R. Anderson and Co., 14, King William-street, W.C. 2. 5506 A

DRAUGHTSMAN, Mechanical, Experienced in Pipe Lay-outs for Cooling Systems, also well versed in Steel Tank Design and Construction.—Address, with particulars of age, experience, and salary required, 5437, The Engineer Office. 5437 A

DRAUGHTSMAN REQUIRED, Experienced in the Design of Water-tube Boilers and Accessories, both for land and marine work. Applicants must give full details of past experience, stating age and salary expected.—Address, 5456, The Engineer Office. 5456 A

DRAUGHTSMAN REQUIRED in England, One with knowledge of Sugar Machinery preferred. State age and fullest particulars.—Address, 5522, The Engineer Office. 5522 A

DRAUGHTSMAN REQUIRED in Kent for 12 to 18 months, experienced in Ferro-concrete and Structural Steel, used to setting out own work. State age and salary.—Address, P3196, The Engineer Office. P3196 A

SITUATIONS OPEN (continued)

DRAUGHTSMEN (THREE) REQUIRED, Temporary, accustomed to Elevator and Conveying Plants, General Engineering, and taking out quantities for estimating purposes.—ROBERT BOBY, Ltd., Bury St. Edmunds 5536 A

DRAUGHTSMEN WANTED for Work in Northern Spain. Experience in Railway Construction and General Civil Engineering essential. Salary £20 to £30 per month, according to qualifications.—Apply, stating age and experience, to COUPER and KER, 4, Deans-yard, Westminster, S.W. 1. P3107 A

EXPERIENCED DRAUGHTSMAN REQUIRED for Rolling Mills; must be competent designer and capable of working with minimum supervision. State age, which should be 28 to 35 years, full details of experience, and salary required.—Address, P3212, The Engineer Office. P3212 A

SEVERAL DRAUGHTSMEN REQUIRED for London office for proposal and detail work. Must have experience in Handling Machinery and Conveyor Plants. Permanent position for suitable men.—Address, stating age, experience, and salary required, P3204, The Engineer Office. P3204 A

STRUCTURAL DRAUGHTSMEN WANTED for Canada.—Address, with full particulars, P3192 The Engineer Office. P3192 A

WANTED, Thoroughly Experienced MACHINE SHOP FOREMAN (must have held similar position), accustomed to modern production, work-shop methods and the handling of labour under day and piecework conditions. State age, experience in detail, and salary required.—Address, 5533, The Engineer Office. 5533 A

FOREMAN and ASSISTANT WORKS MANAGER, age 30/35, energetic, D.O., Plating, and general experience in Shipbuilding Yard. State salary required.—Address, P3215, The Engineer Office. P3215 A

FOREMAN GRINDER REQUIRED in London; should have held a similar position previously and be accustomed to turning out work to a high degree of accuracy.—Address, stating age, details of experience, in date order, and salary required, 5523, The Engineer Office. 5523 A

FOREMAN WANTED for Medium-size Machine Moulding Shop. A live man of proved capacity required.—Address, stating age, experience, and salary required, 5500, The Engineer Office. 5500 A

GENERAL FOUNDRY FOREMAN REQUIRED for Loam and Sand Work. Applicant must be experienced in Metal Mixing; he must be of strong character and able to show the highest references.—Address, stating age, experience, and salary required, 5501, The Engineer Office. 5501 A

WANTED, First-class FITTER who Understands Erection and Repair of Machinery, also used to Motor Car Repairs.—Address, giving references and stating salary required, 5538, The Engineer Office. 5538 A

SITUATIONS WANTED

A COMMERCIAL ENGINEER (36), A.M.I.C.E., A.M.I.M.E., workshop, design, inspection and sales experience with power plant and machinery, REQUIRES POSITION as Sales Manager or Representative. Excellent business record. — Address, P3153, The Engineer Office. P3153 B

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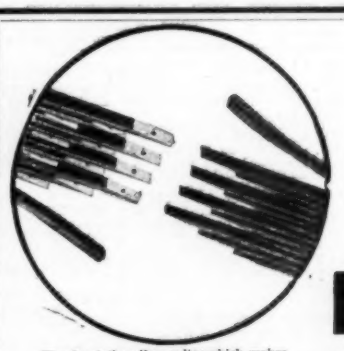

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A Seven-Day Journal

Trade at the Port of London.

AT the last meeting of the Port of London Authority, some figures were presented dealing with the trade of the port and that of the United Kingdom in the year which ended on March 31st. It was shown that the period mentioned was a record one in the history of the port. The total tonnage of vessels which had arrived with cargoes and in ballast was 49,995,610, or an increase of 2,489,000 tons on the return of the year previous. This aggregate was made up of 32,626,229 tons for cargo vessels with an increase of 933,352 tons, and 17,369,381 tons for vessels in ballast condition, an increase of 1,556,508 tons. For the ports of the United Kingdom the total tonnage of vessels arriving and departing with cargoes and in ballast was 278,858,269 tons, a decrease of 31,677,450 tons compared with the previous year. This total was made up of 163,042,915 tons of vessels with cargoes, a decrease of 18,449,354 tons, and 115,815,354 tons of vessels in ballast, also a decrease of 13,230,105 tons. Thus while the London returns showed an increase, a decrease was shown for the ports of the United Kingdom. The total shipping which used the docks belonging to the Authority increased in the period under review by 397,992 registered tons, representing a 2·8 per cent. increase as compared with the 1926 returns. This increase was also a record one. The total tonnage of goods which was landed at the docks controlled by the Port of London Authority was 2,586,968 tons, or an increase of 141,437 tons compared with the total for the previous year. These figures, which are the highest since 1921, are explained by the heavy imports of foreign coal following the strike period.

A New Cross-Channel Service.

ON Sunday evening, May 15th, a new railway and steamship service to the Continent by way of Tilbury and Dunkirk was begun. The new cross-Channel route provides improved transport facilities between northerly towns, also the Liverpool and Manchester district, and the Continent. At the present moment there are through connections to Paris and Bale, and shortly, we understand, trains in connection with the new route will be run to Rome. The crossing is made at night, the vessels leaving Tilbury Dock Basin at 11.30 p.m., and arriving at Dunkirk at 6 a.m. In the reverse direction the boats leave Dunkirk at 12.15 a.m. and arrive at Tilbury at 6.45 in the morning. The Port of London Authority has improved the facilities at Tilbury, and trains now run alongside the vessels. A waiting-room and a Customs house have been built, and accommodation for passengers is provided in the adjoining Tilbury Hotel. The boats, which are run by a new French steamship company, known as the Angleterre–Lorraine–Alsace Société Anonyme de Navigation, were all built by William Denny and Brothers, Ltd., of Dumbarton, and were formerly in the service of the London, Midland and Scottish Railway. They have a net registered tonnage of about 900, and accommodation for 950 to 1240 passengers, with sleeping accommodation for well over 200 first-class passengers. The ships are named the Alsacien, formerly the Duke of Argyle; the Flamand, formerly the Londonderry; and the Lorraine, formerly the Rothmore. A new maritime station has been built at Dunkirk, and special facilities are offered for the fruit and vegetables trades, the steamers being fitted with machinery for the rapid handling of cargo.

The Wilbur Wright Memorial Lecture.

THE fifteenth Wilbur Wright Memorial Lecture was delivered before the Royal Aeronautical Society at the Royal Society of Arts on Monday evening last by Dr. L. Prandtl, of Göttingen, Germany, who took as his subject "The Generation of Vortices in Fluids of Small Viscosity." Dr. Prandtl is the first lecturer to be chosen from outside Anglo-American circles, and in appreciation of his outstanding work in the science of aerodynamics, the Council has conferred upon him the Gold Medal of the Royal Aeronautical Society. In introducing his subject, Dr. Prandtl referred to his own theory of the aerofoil, and gave credit to Professor Lanchester for the work he had done on the same subject, which had led to the theory being known in this country as the Lanchester-Prandtl theory. After referring to Kelvin's theorem, that in a homogeneous frictionless fluid the circulation along every closed fluid line is invariable in time, Dr. Prandtl applied this theorem to the case of a wing, and illustrated and established the conclusion that every confluence at sharp edges can, without contradicting Kelvin's theorem, give rise to a surface distribution of vorticity or a vortex sheet. The lecturer then went on to show that sharp edges were by no means always necessary for the formation of vortices in a slightly viscous liquid, but that shortly after the inception of motion vigorous vortices appeared behind continuously curved bodies, such as circular cylinders. Some photographic and film illustrations of this phenomenon were given. The means of preventing the formation of vortices by using slotted wings and rotating cylinders were discussed, and the importance of turbulent boundary layers which are produced by flows of air over aerofoils and propellers and airship hulls was mentioned. Dr. Prandtl expressed the hope that the theory of turbulent fluid motion would be cleared up by further study of the quantitative deviations from the theory of a perfect fluid, of the actual relations which are apparent in the profile resistance, the diminution of lift, and in the separation of the flow from the wing at large incidences.

The German Cruiser Königsberg.

THE cruiser Königsberg, which was begun at Wilhelmshaven in April, 1926, and launched on March 26th this year, proves to be a vessel of novel design. Her displacement conforms to the Peace Treaty limit of 6000 tons, and she is therefore of the same size as the Emden, the first German post-war cruiser, which was completed in 1925. But here the resemblance ends, for the Königsberg is distinctly superior to the Emden in speed and gun power. The length on the water line is 169 m., the breadth 15·2 m., and the draught 5·3 m. The main propelling machinery comprises two main and two cruising turbines with gearing, operating twin shafts, and taking steam from six double-ended oil-burning boilers, the designed shaft horse-power being 65,000. A speed of at least 32 knots is anticipated. A Diesel unit is installed for cruising purposes, the Königsberg thus being the second large surface warship to be propelled by internal combustion engines, though, as in the case of H.M.S. Adventure, they are only used for cruising speeds. The Königsberg will have an endurance of 5500 miles at an economical speed of 14½ knots. She differs from the Emden—eight 5·9in. guns provisionally on single mountings, but later to be paired in centre-line positions—in being armed with nine 5·9in. guns in triple turrets. The first turret is on the forecastle, the other two are aft, the second being superimposed. Broadside fire is thus from nine guns, while three can fire ahead and six astern. The mounting of guns of this calibre in triple turrets is an innovation. Four 3·4in. A.A. guns and four triple torpedo tubes are also carried. The hull of the ship is constructed of the highest grade steel, and electric welding has been extensively employed. A third and fourth cruiser, presumably of the same class, are to be launched shortly.

Electricity in Essex.

ON Tuesday last the Select Committee of the House of Commons, presided over by Sir John Ganzoni, gave its decision on the Bill promoted by the County of London Electricity Supply Company, which desires to supply electricity in the greater part of the county of Essex. The Committee decided that the preamble of the Bill was proved, subject to the addition to it of a clause providing that within each succeeding twelve months after the passing of the Act the company should submit to the Electricity Commissioners a comprehensive scheme for the supply of electricity in all parts of the added area in which there was a demand for a supply and where no other authorised distributors were empowered to distribute, and if, in the opinion of the Commissioners, the company had not completed the work necessary in the time prescribed, the Minister of Transport might order that the powers of the company should cease as to the whole or any part of the area. The Committee also stated that the special orders sought by Clacton, Colchester and Southend should be heard by the Electricity Commissioners, and that the company should have power to be represented at any inquiry held by the Minister of Transport in respect of those orders.

Reduced Unemployment.

THE statistics regarding the number of unemployed persons in British industry, which are given in the returns published in the Ministry of Labour *Gazette*, show that for the week ended May 9th, the number of persons on the registers of the unemployment exchanges had again fallen below the one million mark. The actual figure for May 9th was 998,300 persons, which number, it has been pointed out, is within 20,000 of being the lowest figure since the end of 1920, when the period of trade depression really begun. In the June of 1921 there were no less than 2,500,000 persons on the unemployment registers, which total has been steadily reduced. On two occasions in the weeks just previous to last year's trade disputes, the total fell below the million mark.

British Patents During 1926.

THE forty-fourth report of the Comptroller-General of Patents, Designs and Trades Marks for the year 1926, which has just been published by the Stationery Office, shows that with the exception of the year 1920, in which there was a post-war rush of applications, the number of complete specifications which were filed last year was the highest yet recorded. The total number of applications for that year was 33,080, or an increase of 77 over the figures for 1925. The complete specifications numbered 19,948, or an increase of 514 over the previous year. There was a slight reduction in the number of applications which were made by way of communication from abroad, which in 1926 numbered 1390, compared with the 1925 figure of 1547. Receipts during 1926 from patents fees amounted to £398,391, those from designs fees were £10,834, and the amount from trade marks fees was £51,117. These figures compare with the totals of £391,677, £11,213, and £46,960 for 1925. The total receipts were £488,152, and showed an increase of £12,108 over the previous year, while salaries were £254,691 in 1926, as against £254,952 in 1925. An excess of receipts over expenditure of £98,813 is recorded.

Petrol Carrying Vessels on the Thames.

THE proposal of the Port of London Authority to amend its by-laws so as to allow ships carrying petrol in bulk to navigate the Thames as far as Crayfordness is being opposed by the Fire Brigade Committee of the London County Council. The Committee points out that in the event of vessels carrying up to 15,000 tons, or about 4,500,000 gallons, suffering collision or meeting with any accident in which petrol was caused to escape, there would be constituted a grave fire menace. The petrol would in all probability be carried by the river tide into reaches and dock areas, and particularly those areas in the vicinity of Woolwich Free Ferry might be threatened. In support of this opinion the case of the fire on the barge Dorcas is cited, which took place off North Woolwich in August, 1920. On that occasion the flaming barge drifted into mid-stream and eventually reached Laboratory Wharf at Woolwich Arsenal. The burning petroleum spread to the river and two tugs, nine barges and a ferry boat were set on fire, and damage was caused to the Ferry pier and warehouses in the vicinity. The new proposal constitutes, in the opinion of the Committee, an increased fire risk, and it is suggested that the existing laws which permit petrol-carrying vessels only to pass up the river as far as the Mucking Light at Thames Haven, which is a little less than 7 miles below Gravesend should stand. The Port of London Authority has announced its intention of submitting the amended by-laws and regulations to the appropriate Government Department for approval.

A New Oil Engine Works for Glasgow.

A NEW company has recently been registered under the style of Fiat British Auxiliaries, Ltd., with works and a registered office at 133, Helen-street, Govan, Glasgow. The head office of the company is at 43, Albemarle-street, London, W. 1, and at an early date it will begin to manufacture at Glasgow oil engines of the Fiat type for marine auxiliary work and land purposes. The engines to be built will be similar in design to those made at the factory of Fiat Stabilimento Grandi Motori at Turin, Italy. The directors of the new company are Sir John Esplen, Bart., Mr. James Caird, Mr. James Howden Hume, Mr. E. W. Harvey and Mr. W. A. Howden. Works are to be taken over by the company which were formerly occupied by Howden-Ljungstrom Preheaters (Land), Ltd., of Glasgow and London, a company associated with James Howden and Co., Ltd. The Helen-street shops are extensive, and they are to be equipped with modern machine tools for the economical and rapid production of various types of oil engines. For the time being engines up to a maximum output of 1500 B.H.P. are contemplated. In Italy Fiat engines have been made in considerable numbers during recent years, both for submarines and passenger and cargo vessels. At the present time there is running in the Fiat factory at Turin a single-cylinder engine which has an output of 2000 B.H.P., and which is reported to be the largest unit cylinder in the world working on the two-cycle double-acting principle.

Some New Shipbuilding Orders.

IT is announced that the Entre Rios Railway Company has ordered from A. and J. Inglis, Ltd., of Pointhouse, Glasgow, a sister ship to the motor train ferry Dolores de Urquiza, which we described in our issue of October 29th last. The engines will be constructed at Harland and Wolff's Glasgow works. An important order on the North-East Coast is that placed by the Booth Line, Ltd., of Liverpool, for two 8500 steamships, which will be built by Hawthorn, Leslie and Co., Ltd., at Hebburn. Sir W. G. Armstrong, Whitworth and Co., Ltd., has received an order from the London and North-Eastern Railway Company, which will be carried out by the engine works department. It will involve the taking out and repairing of three of the pairs of 90ft. entrance gates at the Immingham Dock. The gates will be floated out and towed some 9½ miles up the Humber to the slipway at the dockyard, where the actual repairs will be done. This is a type of work with which Armstrong Whitworth are particularly familiar. Interest has been aroused, both on the Clyde and North-East Coast yards, by the inquiry of the Southern Railway Company for a 24-knot cross-Channel steamer for its Newhaven–Dieppe service. It is understood that the vessel will be propelled by high-pressure geared turbines, and that water-tube boilers similar to the installation on the Clyde steamer King George V. are called for.

20,000 K.W. Parsons Turbo-Alternator at Rotterdam.

No. II. (*Conclusion*).*

THE alternator, constructed by C. A. Parsons and Co., Limited, is of their totally enclosed turbo type, designed for a continuous output of 20,000 kilowatts at 5500 volts with 80 per cent. power factor. A noteworthy feature of the machine is the high rating, namely, 25,000 kilovolt-ampères for a speed as high as 3000 revolutions per minute. The peripheral speed is, however, kept down to the moderate value of 393ft. per second by the adoption of a comparatively long rotor. The exciter is driven from the end of the alternator shaft by a flexible coupling.

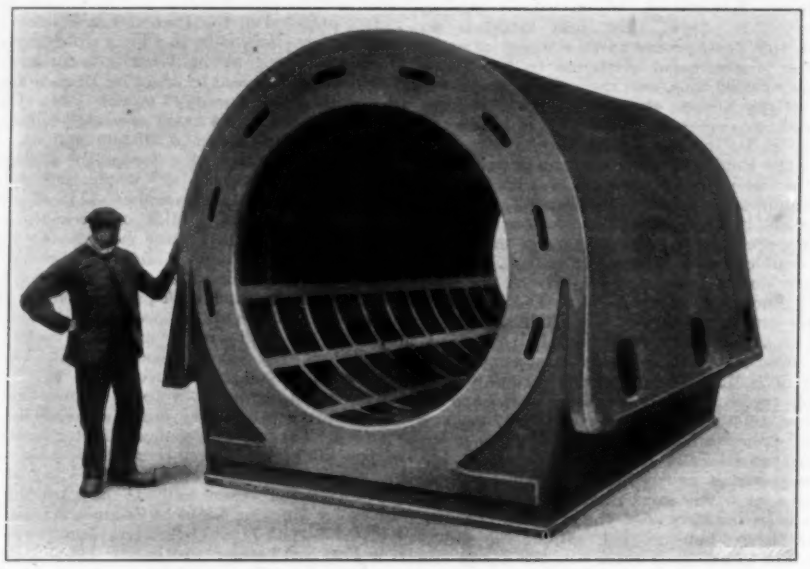


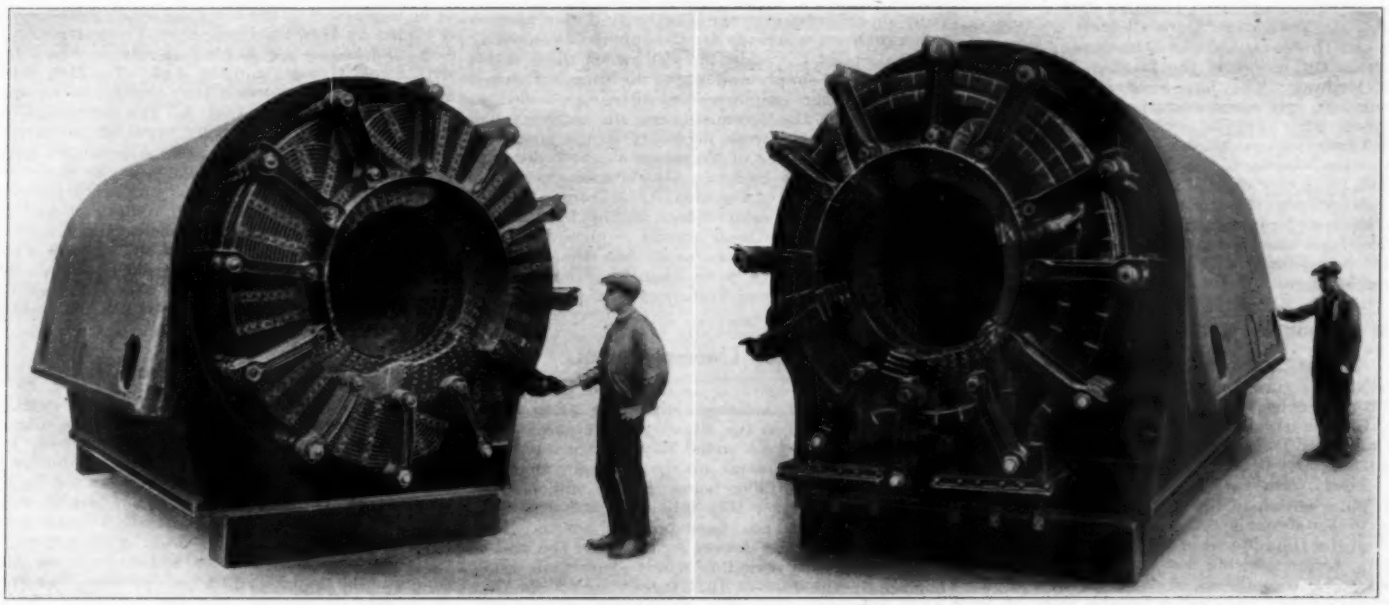
FIG. 5—STATOR CASING OF 20,000 K.W. ALTERNATOR

The stator casing is of cast iron in one piece, with an overall diameter of 8ft. 2½in. Its construction is well shown in the photograph reproduced in Fig. 5. It is, as will be seen, divided by deep internal ribs into a number of chambers, the ribs being stiffened by longitudinal bars which also serve to support the core. These chambers are an essential feature of the Parsons system of ventilation, which will be described later. The core is composed of thin laminations insulated from each other by paper and assembled under heavy pressure. The laminations are in sectors of 60 deg., with their joints staggered, and they are held in position by dovetailed keys bolted to the stator frame. They are secured longitudinally by massive circular end plates having strong steel fingers projecting radially inwards to support the core between the conductors. The conductor slots are totally enclosed, which gives a very strong construction and results in an alternator wave form entirely free from ripples. No longitudinal bolts pass through the core, so that the heating and eddy currents inherent in such construction are avoided. The core conductors are of the Parsons patented helically-stranded coreless cable, each component wire being insulated and spiralled from top to bottom of the conductor several times in its length to avoid eddy currents. The insulation, consisting of micanite with a little presspahn as mechanical support, is moulded around each conductor, the complete conductor being subsequently impregnated with an insulating compound under vacuum. The method of manufacture is such that permanent flexibility, which enables the conductors to withstand the stresses due to temperature when the alternator is in service, is secured. The ends of the conductors are split, and multiple joints are used for connecting the end windings to the slot conductors. This arrangement further minimises the losses due to eddy currents and ensures the efficient cooling of the joints. The end windings are formed of copper strip conductors disposed in three banks. They are fully supported with wood packings and clamped with heavy brass plates. The appearance of the end windings is well shown in Figs. 6 and 7, the former illustrating the completely wound stator as seen from the turbine end, and the latter from the exciter end. Thermo-couples, fitted during the construction of the stator, enable the temperatures at various internal parts, as well as inlet and outlet temperatures of the ventilating air, to be observed at will.

The rotor, together with its shaft, is formed from a solid forging of high-grade mild steel, the slots to receive the field winding being cut out by milling. As in the case of the turbine rotors, a hole is trepanned axially through the shaft from end to end, enabling the condition of the interior to be properly examined to ensure that the forging is free from flaws or defects. The windings are of copper strip, the coils being machine-formed before being placed in the slots. They are connected by flexible leads to slip rings, one at each end of the rotor body. The end turns are protected by moulded asbestos packings and are covered in by weldless nickel-chrome steel end bells electrically connected to the rotor body by a flexible bonding strip. The end bells are provided with grooves in which balancing weights can be fixed where necessary. During construction, the rotor was balanced both statically and dynamically. When completely wound it was run up to 33·5 per cent. over the normal speed and balanced at that speed. The appearance of the finished rotor is shown in Fig. 9, and that of the exciter magnets and brush gear in Fig. 8. The armature of the exciter is driven from the rotor shaft by a flexible coupling, and the magnets are supported on an extension of the alternator bed-plate.

For the cooling of the alternator the closed circuit system of air circulation is employed, the heated air leaving the machine being cooled and re-circulated continuously. The system has the advantages of being comparatively silent, as there is no roar of air entering and leaving the plant, and the discharge of hot air into the engine-room is avoided. The principal benefit, however, of the closed system is the maintenance of the cleanliness of the alternator. There is no continuous supply of fresh dust and dirt being delivered to the machine, as is so often the case when air filters are ineffective or absent, and the air for cooling is drawn from outside. A further advantage is the minimising of any damage due to a short circuit, as the limited amount of air in circulation is insufficient to support combustion for any appreciable length of time. The system of alternator ventilation as applied to the Parsons machine at Rotterdam is illustrated in Fig. 10. The air cooler "C," which is incorporated in the foundation block, is built in two sections, each being mounted on wheels running on guides in the floor, so that it can easily be withdrawn for inspection. Each section has also a T bar at the top, which slides between a pair of angle guides fixed to the ceiling of the chamber. The cooler is formed of tinned copper tubes, with gills sweated on. The water supply is induced by means of

FIG. 8—EXCITER MAGNETS AND BRUSH GEAR



FIGS. 6 AND 7—END WINDINGS OF STATOR

* No. I. appeared May 13th.

a small motor-driven pump and the pressure in the tubes is always below that of the atmosphere. A motor-driven fan "D" forces the air through the duct "A," through the alternator, and thence through the cooler "C," whence it returns to the fan inlet, cool and ready for another cycle, through the suction branches "E" shown in the drawing. In emergency, free air can be circulated through the alternator, the air being drawn in through the emergency inlet doors "G" and discharged through the emergency outlet door "F." These doors "G" and "F" normally serve for inspection purposes. An index thermometer for indicating the temperature of the air leaving the alternator is fitted to the side of the stator casing. To give warning, should the temperature of the air become unduly high, when it reaches a predetermined figure an automatic device comes into operation and sounds a Klaxon horn and lights a danger lamp.

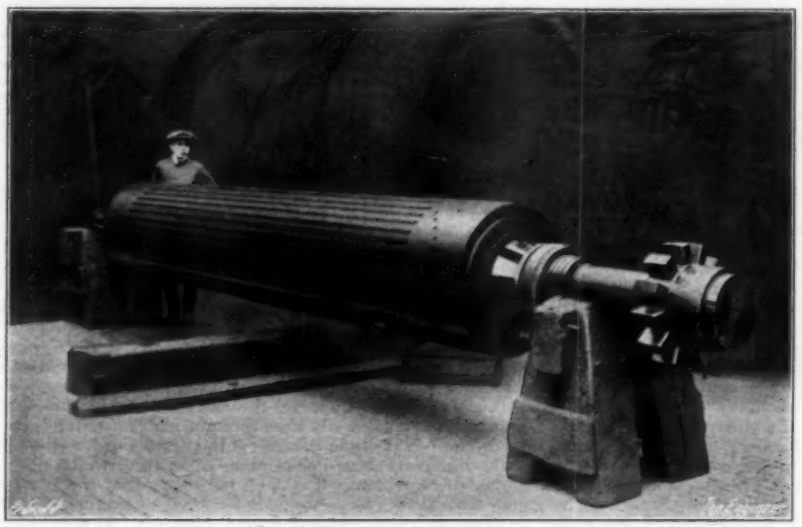


FIG. 9—ROTOR OF 20,000 K.W. ALTERNATOR

In connection with the alternator ventilation system the method by which the cooling air is introduced into the interior of the machine itself should be particularly noted. The method, which is patented by Messrs. Parsons, is not only extremely effective, but permits the cooling of the longest machines as efficiently and easily as those of moderate length. Reference to Fig. 5 will show that the casing of the alternator is divided into eleven compartments by a number of circumferential ribs, tied together by horizontal bars which serve to hold the core. The odd-numbered compartments, counting from either end are all connected in parallel to the air supply, from the fan and form ducts through which the air is led radially through the core. From these pressure chambers, as they may be called, the air passes into the core, through the core ducts provided for that purpose. Some of it blows straight on to the rotor and then, passing axially along the air gap, returns by way of other core ducts into the even-numbered compartments and so to the cooler. For the further cooling of the stator there is a row of axial holes through the laminations behind the conductor slots. Some of the cold air coming down the core ducts is short-circuited by these holes and can pass axially through the core into the exit core ducts without going as far as the air gap. The stator is thus very effectively cooled and the cooling is well distributed along its entire length. The end windings are cooled by air which blows over them, coming through ports communicating with the end chambers of the casing. The rotor has its own system of ventilation in addition to being subject to the action of the air coming through the stator. There are ports in the end of the rotor body through which air is induced by the rotation of the machine, and this air passes axially along channels in the pole face and escapes by radial openings opposite the exhaust chambers of the stator. Air is also circulated through the rotor end connections and discharged through holes in the walls of the end bells.

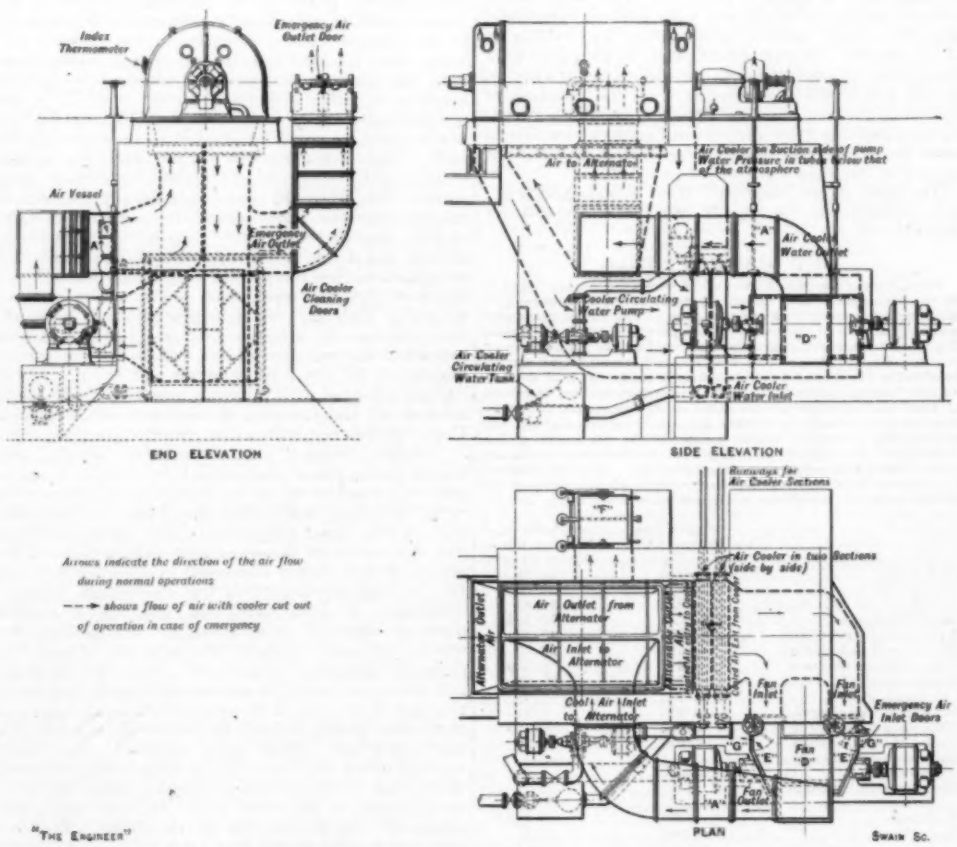

Index Thermometer
Emergency Air Outlet Door
Air Vessel
Emergency Air Outlet
Air Cooler Cleaning Doors
END ELEVATION
Air to Alternator
Air Cooler on Suction side of pump. Water Pressure in tubes below that of the atmosphere
Air Cooler Water Outlet
Air Cooler Circulating Water Pump
Air Cooler Circulating Water Tank
Air Cooler Water Inlet
SIDE ELEVATION
Runways for Air Cooler Sections
Air Cooler in two Sections (side by side)
Air Outlet from Alternator
Air Inlet to Alternator
Cool Air Inlet to Alternator
Fan Inlet
Emergency Air Inlet Doors
Fan Outlet
PLAN
Arrows indicate the direction of the air flow during normal operations
shows flow of air with cooler cut out of operation in case of emergency
"THE ENGINEER"
SWAIN Sc.

FIG. 10—ARRANGEMENT OF PARSONS' ALTERNATOR VENTILATION SYSTEM

We have, in conclusion, to thank C. A. Parsons and Co., Ltd., for enabling us to give so full a description of this important machine and for placing drawings and photographs at our disposal. The company is also to be congratulated on securing an order to demonstrate on the Continent the merits of a genuinely British steam turbine and high-speed alternator.

Iron and Steel Institute.

No. II. (*Conclusion*).*

THE first paper taken on Friday morning, May 6th, was "The Drawing of Steel Wire and its relation to Qualities of Steel," by Mr. E. A. Atkins. A condensed reprint of this paper will be found elsewhere in this issue.

STEEL WIRE DRAWING.

Professor Henry Louis said that the author, like all English authorities, was strongly in favour of the torsion test, but recent authoritative German work had discarded that test entirely in favour of the to-and-fro bending test at right angles. What had the author to say on that point, and why was this latter test not more largely used in this country? With regard to the discovery of hidden flaws in wires, a certain amount of work in that direction had been done in America by electro-magnetic methods, and X-rays had also been used for the purpose. Had the author any experience of these methods having regard to the fact that he had stated in the paper that there was no possibility of detecting these flaws. It would be a matter of enormous importance, and would help to save a good many lives if such methods were successful.

Mr. W. H. Wilkinson, referring to the author's statement that wire of a supposedly good quality broke with a square or solid fracture, said that that remark was quite true in his experience, whilst wire of an inferior quality broke in a ragged fashion. He had also often found that a wire which was extremely brittle and would only stand one snarl would give the requisite number of torsions and break with a solid fracture, whereas wire which gave the requisite number of torsions and broke with a ragged fracture was seldom found to be brittle.

Mr. Dartrey Lewis also suggested that interna flaws might be detected by X-rays. He had shown the paper to Mr. Thomas, of the Radiological Department at Woolwich Arsenal, and that gentleman had carried out some experiments. The radiological equipment at Woolwich was, he said, the finest in the world, and extensive examinations of metals had been carried out in the department. Castings had been examined, and internal flaws had been detected in welds quite readily. An experiment had been tried on a piece of ½in. rod cut down the centre, the halves being placed together again and then X-rayed. Before placing the two pieces of wire together three small holes were drilled a short way into the inner surface of one of the pieces, and the X-ray photograph showed these holes clearly. That result suggested that internal flaws could be detected by such means.

Mr. A. T. Adams, after commenting on the fact that it was a considerable time since a paper on wire was discussed before the Institute, said that in the case mentioned by the author of butt welding a high-carbon wire to a mild steel wire—he took it that the wire was in the tempered condition—there was no uneven flow of the wire, and that seemed peculiar at first. Did high carbon wire draw more uniformly than soft mild steel? His own experiments had shown that the sorbitic structure drew more uniformly even than the ferrite structure. As to oxide inclusions, perhaps he had been more fortunate than the author in the steels he had handled. Whilst pulling out seemed to be one of the most serious troubles the wire drawer had to contend with, he personally had not had the unfortunate experiences the author appeared to indicate. It was very rare that he had found a steel which could not be drawn. On one occasion he had a cast which had been given up as hopeless in the first instance, but which was found to draw beautifully six months afterwards. Apparently the weathering had improved it by helping to clear the surface of some of the embedded scale. Whilst he did not wish to dispute the author's conclusions regarding aluminium oxide and specks, it would be interesting to know whether or not those specks affected the pulling out, because, when he had to rely on micro-sections to investigate mild steels, he nearly always found specks in every section. On one occasion he had complained of one steel being dirty, but he had been told by a very eminent metallurgist that he did not know how to polish sections! There might be some truth in that, but there was also a good deal of truth in the point that it was possible to over-polish steel and hide defects by causing surface flow. A test which he had found even more useful than micro-examination was to examine the structure of the drawn wire itself. He had invariably found that a dirty steel gave a wavy structure and a pure steel a very regular structure. Without going into the merits of the bending and torsional tests, he expressed the hope that, if the bending test were established in this country, the bending machine used

* No. I. appeared May 13th.

and the method of carrying out the test would be most rigidly standardised because it was possible to get very great variations by differences in the way the bend was carried out.

Dr. Walter Rosenhain remarked that the cuppy fracture was by no means new, and had been described, although not for the first time, in the ninth or tenth Alloys Research Report on Aluminium-bronze. In that case, the cuppy fracture was obtained when there was no question of segregation. Was the author certain that the internal cuppy fracture was not likely to be produced by wrong manipulation in drawing by, for example, over-drawing the wire? It seemed to him that if the relation of the force used and the angle of the die-plate, reduction, &c., were not correct, it was possible, even with a homogeneous material, to draw the core of the wire unduly fast relatively to the periphery and for the core to break up. Therefore, it might not necessarily be right to ascribe the cupping of the wire to segregation, although segregation would cause it under conditions which otherwise would not produce it. The question of oxide and its function was interesting, but one was inclined to forget that the solubility of iron oxide in steel was very low indeed. The solubility in pure iron was in the second place of decimals, and although we did not know precisely what was the effect of carbon on that figure, it was perfectly safe to assume that the presence of carbon would not increase the amount of oxide which could be held in solid solution. A great deal of misconception existed as to the function of oxide of iron, and he would be happier to see minute inclusions of iron oxide in a steel than a good many other inclusions which were always met in greater or less degree. Fremont, in *Le Génie Civil*, had recently condemned methods of testing wire in a wholesale manner. One aspect of the question which was important was the fatigue resistance of steel wire. Mining ropes, for instance, were not only subjected to bending, but also to corrosive influences, and it had been shown, both in America and in this country, that these combined influences were particularly destructive. There was no mention in the paper of fatigue, yet that factor might be more important in the case of mining ropes than the number of twists or the tensile strength. Fatigue was also interesting from the point of view of the life of spiral springs. It was common knowledge that the performance of spiral springs was not all that could be desired.

Mr. E. H. Saniter, responding to a request by the President that steel makers should speak in the discussion, suggested that one reason why steel makers had not spoken was perhaps that they felt as he did, that the author had treated them very fairly in the paper and left them nothing to grumble about. As regards segregation he could tell the author that he could have steel without segregation if he would pay the price. His experience of the microscopic examination of steel for inclusions was that no two observers agreed in their estimates, and, therefore, when the author spoke of 50 million inclusions in a cubic inch, it meant that they must be almost as small as molecules. Perhaps an appendix might be added to the paper indicating the method of calculation! Referring to oxide in steel, Mr. Saniter said that the bulk of the mild steel used for drawing wire contained as much oxide as steel could contain in the solid condition. It was full of blow-holes before it was rolled, and yet the author would confirm him in saying that nothing drew more sweetly than a piece of fresh mild steel. Did the author really find nearly 100 per cent. alumina in the crystals he had mentioned? Was there not a proportion of manganese and silica as well?

Mr. Benjamin Talbot expressed particular interest in the question of oxide of iron in solution in the steel. Some pure iron—99·8 per cent. pure—was heavily dosed with aluminium, and it would be very interesting to see how that material worked out under the treatment of wire drawing. Others had no aluminium at all and the experience at the rolling mills was that the metal without aluminium rolled much better than the one with aluminium. In view of the alumina crystals referred to, it would be interesting to ascertain whether there would be any differences in drawing fine wire.

Dr. T. Swinden expressed the view that the information in the paper concerning the alumina crystals was a very distinct advance in our knowledge of the troubles encountered in wire drawing. Although Mr. Saniter had said the author had treated the steel makers very well, there were, in fact, four or five pages relating to defects in steel making, and he himself, as a steel maker, had received rather a shock when reading the comments on non-sizing. It had been recognised in his works for ten years that additions of aluminium in the higher carbon steels were detrimental from the sizing point of view, and the author had made a great advance in proving the specks to be alumina. At the same time, the number of the specks was by no means so important as their character. Non-sizing was essentially a matter of the surface condition of the steel, and the point made by a previous speaker of a steel being bad for wire drawing at one time and proving quite satisfactory after weathering was a good example. Unless a steel was properly cleaned and blued, the very best material would give trouble in wire drawing as regarded size, and he questioned seriously whether wire drawers had paid sufficient attention to that important point in the development of wire-drawing machines to make allowance for the difference in conditions now and twenty years ago, when there were not such heavy reductions nor such long drawings. It was a common experience of steel makers to send a cast of steel to three or four wire drawers, and to be told by some that it was the best they had ever had, whilst others would say they could do nothing at all with it.

Dr. W. H. Hatfield also thanked the author for his fair treatment of steel makers. Listening to the discussion, he confessed that he was not convinced of the soundness of the author's contention concerning the influence of inclusions, particularly alumina. The reason was that, not so long ago, he produced experimentally a considerable batch of wire in which aluminium was present in considerable quantity. He did not at the time examine that wire for alumina inclusions, but he thought the inference was clear that steel heavily charged with aluminium must contain a substantial amount of alumina in finely divided particles, but there was no difficulty in drawing arising from that cause. Therefore more evidence was required in support of the contention in the paper.

Mr. Atkins, in his reply to the discussion, which was the only reasonably full one during the day, remarked that it was stated in the paper that the torsion test had no particular value except that it gave some measure of solidity of the material. The point was that wire drawers had to produce wire to a torsion specification. They were told that the wire must stand so many twists in a length of 100 diameters, but he could say emphatically that if a wire would only give twenty twists, and thirty were wanted, the thirty twists could be obtained with a little doctoring. That showed the value of the test. Whilst it was certain that X-rays would discover breaks in a wire, he conceived it was going to be a difficult job to apply X-rays to 30 gauge wire that might run to a length of 300 miles. If it could be tested in the mass, the method would be practicable. However, there were already so many tests carried out in a wire works that he did not think it necessary to add X-rays. As to there being flow in high-carbon wire, that was what he discovered, although further work was no doubt required on the point. With regard to alumina crystals, the tests were carried out by the addition of aluminium to the ingot moulds in certain quantities, and the ingots were rolled down and drawn into wire. In those cases in which aluminium was not added to the steel, he did not find alumina crystals. On the question of specks and their nature, it required training and experience to deal with them. He did not suggest that the alumina crystals were absolutely pure, but they were tested very carefully by treatment with sodium carbonate, and washed and ultimately converted into hydroxide of aluminium. It was possible that there might have been traces of manganese, but it was doubtful whether it was worth while continuing with the question of the nature of the crystals. He had, however, made up his mind that they were the inclusions which caused the trouble, and care was now taken that they did not appear in the steel if it could be helped.

The next paper, entitled "Heat Resisting Steels," was presented by Dr. W. H. Hatfield. An abstract follows:—

HEAT-RESISTING STEELS.

The nature of the attack from which steels suffer when exposed to the atmosphere and industrial gases at high temperatures was studied by means of samples about 1 cm. in diameter and weighing about 20 grammes. The specimens were in general exposed for twenty-four hours at 900 deg. Cent. to various atmospheres, and their increase in weight in milligrammes per square centimetre of surface was subsequently measured and entered as the "index figure." The atmospheres employed consisted of pure and atmospheric air alone or contaminated with 2 to 5 per cent. of moisture, sulphur dioxide or carbon dioxide, the atmosphere prevailing inside an unenclosed gas muffle and a "complex" gas synthetised to represent the average composition of the products of combustion of various fuels. The index figures for various materials exposed to the "complex" gas and the muffle furnace atmospheres are given below:—

Material.	Complex Gas at 900 deg. Cent. Index Figure.	Muffle at 900 deg. Cent. Index Figure.
Pure iron	114·012	95·34
Chromium	2·051	1·00
Nickel	5·222	16·83
Mild carbon steel	80·225	73·104
3 per cent. nickel steel	72·893	43·30
36 per cent. nickel steel	30·058	27·70
Silicon-chromium steel	0·84	0·306
Chromium steel	18·319	20·50
Chromium steel	1·252	1·38
Chromium nickel steel	6·000	3·84
Chromium-nickel steel	2·699	0·326
Nickel-chromium steel	2·534	1·01
Chromium-nickel-silicon steel	0·689	0·061
Chromium-nickel-tungsten steel	0·43	0·175
Nichrome	1·397	0·765
Cast iron	86·000	33·80
15 per cent. silicon iron	78·434	13·734
Monel metal	68·676	1·55

The complex gas, representing the industrial products of combustion, is more active in attacking the materials than the muffle atmosphere, which not only consists of some unburnt combustibles, but also contains a definitely less proportion of sulphur dioxide. As a result of the research, the author holds the view that steam and SO_2 in the gases materially increase the difficulties of withstanding their action. Sulphur dioxide resulting from the fuels used is one of the essential influences which the metallurgist is called upon to combat. A survey of the data presented results in the detection of several anomalies of such consequence that it is evident that one cannot deduce, from the behaviour of the constituent metals and elements, what the response of the alloy produced from them will be under a given set of experimental or service conditions. The protective action of chromium is generally confirmed. With pure nickel in SO_2 there was a heavy attack at 800 deg. Cent., but the attack diminished materially at 900 deg. Cent., and became practically negligible at 1000 deg. Cent. That nickel is a valuable element in heat-resisting steels has also been established by other investigators. The influence of silicon and tungsten in further increasing the resistance would appear to be fully established. In the case of tungsten this effect is certainly anomalous, since the experiments disclose an abnormal attack in oxygen, a heavy attack in steam, but a materially diminished attack in CO_2 and SO_2. The main feature of the paper is the attempt to establish quantitatively the fact that these added elements produce steels which satisfactorily resist attack at high temperatures, and amongst such can safely be cited certain compositions in the chromium, the silicon-chromium, chromium-nickel, chromium-nickel-silicon, and chronium-nickel-tungsten series. Some of these steels have extremely satisfactory characteristics as regards resistance to corroding media under the conditions studied, and are fitted for much wider service than that in which they are at present employed. The author kept to the problem of corrosion-resistance at high temperatures, and did not complicate the considerations of the materials by dealing with their mechanical characteristics. That aspect of the matter is being dealt with separately, but it may be sufficient to state that a similar quantitative increase in strength at high temperatures is being obtained, in certain cases, as a result of similar modifications in composition.

Mr. T. G. Elliott expressed some disappointment with the paper, as he had expected from the title a more comprehensive treatment of the subject. The tests described were typical of tests carried out in the laboratory of his own firm some years ago, and, as a matter of fact, every new steel tested for heat-resisting properties was tested by a laboratory method of the type described in the paper. At the same time it was inadvisable to place too much reliance upon a laboratory test of that nature. For instance, he had tested at 850 deg. Cent., steels having a similar composition to the author's chromium-nickel-tungsten and silicon-chromium alloys. After three hours the loss in the case of the first-named was ·04 gramme per square centimetre of surface, whilst after fifty-eight hours it was ·1, indicating that the first test, if taken alone, would have been misleading. In the case of the second steel, the loss was ·02 after three hours and ·05 after fifty-five hours. In long-period tests at high temperatures in a works furnace, there was very little change at 930 deg. Cent. up to the first 300 hours in the case of both alloys, but after that the second alloy commenced rapidly to deteriorate, whilst the first lasted for several hundred hours before commencing to deteriorate. Thus up to 300 hours, one might imagine that both alloys were more or less alike.

Mr. U. R. Evans did not share the disappointment of Mr. Elliott, and said that metallurgical science was indebted to the detailed accounts of research work issued from the laboratory under Dr. Hatfield's control. In point of completeness and frankness the paper set an excellent example of the way in which an industrial laboratory could contribute to the solution both of scientific and economic problems. Dr. Hatfield rightly laid stress on the great oxidising action upon metals of ordinary products of combustion when compared with that of a gas characteristic of a muffle furnace. Probably that result might be partly attributed to the fact that the former contained much free oxygen, whilst the sample of the latter employed contained free carbon monoxide. Dr. Hatfield was undoubtedly correct in emphasising the part played by sulphur dioxide, carbon dioxide and water vapour in stimulating attack, and it was noteworthy that those same bodies also promoted low temperature corrosion. He believed, however, that the mechanism of the action of those bodies at high and low temperatures was different. For instance, at low temperatures sulphur dioxide promoted the corrosion of iron only in the presence of moisture. If moisture were present on the metal, rusting occurred with alarming speed, and the action showed all the features of electro-chemical attack. Under proper conditions one obtained intense action at certain minute points—probably anodic pits. These points were surrounded by bright areas of perfectly circular form—probably the corresponding cathodic areas. Apart from the thinness of the water film and the good supply of oxygen, the mechanism did not seem to be essentially different from the attack of iron deeply immersed in a corrosive water. But at high temperatures the mechanism must be different. In such cases the influence of sulphur dioxide, although stimulated by the presence of water, proceeded without the addition of any considerable quantity of moisture. The work of Baker and the more recent researches of Norrish had led to the idea in the minds of some metallurgists that perfectly dry metals would not suffer oxidation in perfectly dry air. That idea, however, was hardly warranted by the facts, for it seemed fairly certain that other polar substances besides water could act catalytically in the same way. He had had a conversation with Dr. Norrish on the subject a few days ago, and he had stated that he would not expect the high-temperature oxidation of metals to be inhibited by drying. He also pointed out that probably at the high temperatures used by Dr. Hatfield even reactions which would require the presence of water or a polar substance at ordinary temperatures would, in many cases, proceed without a catalyst owing to the enhanced energy of the molecules at high temperature. Experimental results, although not conclusive, seemed to bear out those views.

Colonel N. T. Belaiew said that thermal expansibility had a good deal to do with the properties of heat-resisting steels. Chromium was very beneficial in preventing corrosion and erosion in guns, but even

if chromium were absent there were some nickel steels which were not expected to be very heat resisting, yet sometimes were. That was a point he would like Dr. Hatfield to explain. Everybody would look forward to the results of the mechanical tests that had been promised.

Dr. C. A. Benedicks said that the most striking feature of the paper appeared to him to be its revelation of the fact that silicon gave a very high resistance against oxidation. That fact had been confirmed by other workers and the explanation might be found in the oxygen-containing layer surrounding the metal. While working on the corrosion of several substances in sulphate cellulose lye which contained a considerable amount of sodium hydrate he had found that silicon steel was by far the most badly attacked of all. The conditions were, however, different from those described in the paper, because any oxide film would easily be dissolved by the sodium hydrate in the solution. It was found, at first to his considerable astonishment, that stainless steel afforded much less protection against the sulphate cellulose lye than did pure iron. He would like to know whether the author thought the silicon was beneficial in every case to promote heat-resisting properties or was it a necessary condition that, on heating, the critical temperature should not be exceeded. It occurred to him that the enormous changes at that temperature would reduce the protection afforded by the silicon and make it less trustworthy.

The President pointed out that the author seemed to suggest that, in the presence of SO_2, nickel and tungsten steels were likely to be more protected than a steel with chromium alone. No doubt within the range of the experiments described in the paper that was true, but he himself had known of certain cases in which alloys of chromium alone had been working in an oxidising atmosphere for many months with extraordinarily good results. In fact, some of those alloys had been working at a temperature of over 900 deg. for nearly a year with very little action upon them.

Dr. Hatfield, who did not reply to the discussion generally, said that he had wished to concentrate attention in the paper on the question of chemical attack and therefore he had left the mechanical properties out of it. At the same time it was really the difference in mechanical properties at high temperatures that was the main recommendation of the special steels dealt with.

Professor C. A. Edwards then read the paper by himself and Mr. J. C. Jones on "The Influence of Annealing Temperature on the Properties of Mild Steel Sheets." An abstract of this paper follows.

ANNEALING TEMPERATURES AND MILD STEEL SHEETS.

The authors examined the effect of annealing temperatures on the properties of mild steel sheets intended for the manufacture of tin-plates. The effects studied were the influence of the annealing temperature on the Erichsen test values of sheets ranging from 0·33 to 1·25 mm. thick and the influence of the annealing temperature on the tensile properties of sheets 0·4 mm. and 1·25 mm. thick. As regards the Erichsen values, it is shown that the greater part of the rolling stresses left in the sheets from the hot-rolling mills was removed by annealing at temperatures of 625 deg. Cent. to 650 deg. Cent. In most instances a further substantial improvement occurred after the temperature was raised above the A_3 transformation. Within these two limits of temperature, 650 deg. Cent. and 920 deg. Cent., the results obtained were, comparatively speaking, constant for each material. There are, however, indications in some cases that somewhat better results were obtained at 700 deg. Cent. than at any higher temperature up to 900 deg. Cent. This is certainly the case for sheets 0·5 mm. thick, and it is thought that the deterioration in the values, on raising the annealing temperature above 700 deg. Cent., was due to the coarsening of the ferrite crystals. It may be found possible so to adjust the period of annealing at about 700 deg. Cent. as to obtain small equiaxed crystals in the steel, and thus get results that will equal, if they do not surpass, any that can be obtained by annealing above the A_3 change point. With quite high phosphorus and sulphur contents in the steel, very good Erichsen values can be obtained by annealing at temperatures around 1000 deg. Cent. The most interesting features revealed by tensile test experiments are those relating to ductility. It was found that after annealing at about 700 deg. Cent. the elongations of the 0·4 mm. specimens, when tested in the direction of sheet rolling, were considerably higher than when tested in the other direction; but the difference in this respect was small after annealing above 900 deg. Cent. Between these limits the curves show distinct minima corresponding with a temperature of about 800 deg. Cent. With regard to the 1·25 mm. specimen, the tensile properties were more regular when tested at right angles to the direction of sheet-rolling than when tested in the other direction, and, generally speaking, the elongation values were better in the former than in the latter case. Extremely low elongation results were obtained for this sheet when tested parallel with the direction of sheet-rolling after annealing at 900 deg. Cent.

Mr. W. R. Davies, speaking as a representative of the tin-plate industry, said that the results of many of the tests recorded by the authors, required confirmation before they could be regarded as conclusive. If the author's Erichsen values varied 5 or 6 per cent. in the laboratory, it was not surprising that there should be the vexatious variations in the works which were often encountered. The authors, he continued, had dealt with their subject entirely from the point of view of the rolling stresses. He was interested in the subject from the point of view of the production of very thin sheets. The removal of rolling stresses was not the only problem encountered in the first annealing of such sheets. The practical man required the assistance of the scientist in connection with the thorough cleansing of the surface from water stains. Such cleansing was necessary before a satisfactory tin-plate could be manufactured, and any information as to the critical point at which the stains were removed would be of immense value to the tin-plate industry. In the tin-plate industry, immediately following the first annealing, there was the cold rolling process. He did not know whether the authors had measured to what extent the cold rolling process affected the strength of the plate and at what temperature it was necessary to anneal in order to recover the strength and ductility of the once-annealed plates. He had carried out a few tests on those lines, and whereas the once-annealed plate gave an Erichsen value of 8·05, that same plate, after cold rolling, gave a reduced Erichsen value of 6·50. A second test, before cold rolling, showed a figure of 7·50, which was reduced to 6·25, and a third test showed a figure of 6·50 after cold rolling. There was no consistency in the results, and the tin-plate industry wished to know how to restore the plates to their original strength and ductility after they had been cold rolled.

Mr. Archibald Allinson pointed out that very often the edge of a slab ultimately became the surface of a sheet, and suggested that different results would be obtained in practice from what might be expected from the data set out in the paper.

Professor J. H. Andrews said that one feature of the Erichsen curves was that they showed a big peak at about 650 deg. Cent., and as the thickness of the plate increased, there was a second temperature peak at about 900 deg. Cent. There was a tendency for a bigger break in the neighbourhood of 900 deg. Cent. for the thinner sheets. Had the authors any explanation to offer of that curious point?

Professor Edwards, replying to one or two points, said that he and his co-authors had carefully studied the question of the removal of water stains, and had come to the conclusion that water stains were completely removed if the temperature reached something of the order of a little over 700 deg. Cent. By that he meant the actual temperature of the sheets. It was often very difficult to differentiate between the temperature of the furnace and the temperature at different parts of the batch of sheets, but if 700 deg. Cent. was reached in the sheets themselves, the water stains would be removed. Similarly, he thought it could be stated emphatically that all cold-rolling stresses were completely removed, provided that the temperature exceeded 650 deg. Cent. That meant that the bottom of the batch must reach 650 deg., which would correspond to a temperature of about 700 deg. or more in order to allow for the heat to soak through into the interior. Dealing with the influence of variations in the thickness of the bars on the properties of the sheets in relation to the two directions of rolling, he said that when the work described in the paper was extended, it would probably be possible to indicate the right kind of bar to use for any particular size of sheet, so that the best results could be obtained in the two directions of rolling with the minimum of trouble as regarded annealing. In reply to Professor Andrews, he stated that the difference in the tests referred to was entirely due to differences in the finishing temperature. The thinner sheets naturally finished at a lower temperature, and there was more of what might be called strain work left in them.

The first paper taken at the afternoon session was that by Dr. T. Swinden and Mr. G. R. Bolsover on "Some Notes on Cold Rolled Strip." The following is the authors' own summary of the paper.

COLD-ROLLED STRIP STEEL.

Various mechanical properties have been determined, after varying amounts of cold work by rolling, on steels containing 0·10, 0·34, 0·54 and 0·70 per cent. carbon, the 0·54 per cent. carbon steel being in two, and the 0·70 per cent. carbon steel in three different conditions prior to cold rolling. The maximum stress in tension increased with cold working, but for a given percentage reduction by cold work the increase was proportionately less as the amount of cold work previously received by the steel increased. The proof stress was found to follow very closely the maximum stress in tension, but to be proportionately less as the carbon content of the steel increased. The resistance to shear increased with cold working, but to a less degree than the maximum stress in tension. Brinell hardness tests on cold-worked materials were found to be unreliable as an indication of the maximum stress in tension, but in general the ratio between these two tests increased with the cold work. In general, the variation in properties was similar in the various steels dealt with, but it was shown that on all tests taken the dead soft steel—such as is used for cold-press work—hardened appreciably less by cold work than any of the other strips tested; while a 0·70 per cent. carbon steel, annealed before cold rolling, work-hardened more readily, particularly as measured by the Brinell test. There was no indication in the authors' tests, nor in their general experience, of a fall in hardness on progressive cold rolling, as suggested by some workers.

Similar tests were made on five of the steels in question after reductions in thickness of approximately 33 and 66 per cent., followed by heating for one hour to various temperatures up to 700 deg. Cent. The maximum stress in tension increased with the rise of reheating temperature to approximately 300 deg. Cent. in all steels, with the exception of the dead soft strip, and fell with increasing temperature above this point. Annealing before cold rolling reduced the rise obtained by reheating after rolling. The proof stress increased both in amount and in proportion to the maximum stress up to approximately 300 deg. Cent., after which both these values fell. Such increases were greater the higher the carbon content and the greater the amount of cold work received. The resistance to shear also increased up to approximately 300 deg. Cent., the dead soft strip being affected in the same manner as, but to a less degree than, the remaining steels, the rise again being proportional to the amount of cold rolling. Not only did the Brinell hardness rise on reheating, but the ratio to the maximum stress fell, thus giving a higher proportional rise for the Brinell number than for the maximum stress. The time of reheating beyond one hour at 700 deg. Cent. was shown to have a decided influence on the mechanical properties.

Mr. Archibald Allison said that his experience was that the scleroscope test was more reliable than the Brinell hardness test for strip steel. The modern theory of the hardening of mild steel would to some extent account for the fact that dead mild steel did not harden up proportionately, because the supply of crystals favourably oriented for receiving deformation became exhausted, which accounted for the hardening not being progressive in dead soft steel. In a harder steel, the supply of crystals was more quickly exhausted, the material was more uniform and the hardening was more uniformly progressive. As to spread, the solution of the position stated by the authors was to be found in the somewhat unusual sizes selected for rolling, viz., 1in. wide by 0·3in. thick. Had the pieces been, say, 3in. by ·15in. thick, the question of spread would hardly have arisen. At the same time, the information given was valuable for the size quoted, although it was not only likely to be commonly used in practice.

Mr. J. S. G. Primrose suggested that it would be useful to have some co-relation between Erichsen values and the authors' hardness tests. A number of people took great care in carrying out hardness tests on cold rolled material and others were very careless. A co-relation such as he had suggested would be extremely useful for big stamping work.

Dr. W. H. Hatfield remarked that although the authors spoke of the somewhat indefinite relationship of the Brinell test to the tensile test, he was not so sure that at present we should not speak of the somewhat indefinite relationship of the tensile test to the Brinell test.

Mr. Bolsover, replying briefly, entirely disagreed with Mr. Allison concerning the value of the scleroscope for strip steel. The progressive hardening of steel was bound up largely with the composition of the steel. Two steels of the same composition, but with slight differences in their method of production, were likely to give very big differences in the response to subsequent tests, after cold rolling. In reply to Mr. Primrose, he stated that Erichsen tests had been carried out on a similar series of steels, but it was not thought worth while publishing the results, for the simple reason that the variation in the thickness of the strip eliminated the possibility of comparison. In reply to Dr. Hatfield he stated that the Brinell test had very little value for the particular purpose covered by the paper.

Dr. C. Benedicks then read the paper by himself and M. H. Loquist on "Theory of the Growth of Cast Iron Repeatedly Heated." We append an abstract of this paper.

THE GROWTH OF CAST IRON.

Objects of grey cast iron, subjected to repeated heatings to higher temperatures, show a tendency to increase in volume, as much as, for instance, 20 per cent., thereby also increasing in brittleness. In practice this phenomenon is met with in such objects as annealing ovens, annealing boxes, furnace grates, ingot moulds, &c.—In their paper the authors expound a rational theory of this somewhat complicated phenomenon. It is well known that a homogeneous metal cylinder, having been repeatedly quenched in water from a glowing state, undergoes an easily observed permanent shortening.

The explanation is quite simple; on the immersion of the hot cylinder into the water, the outer layer is quickly cooled, and is consequently subjected to a sudden contraction. This will exert a considerable contraction stress on the inner, still warm layers, which will be noticeable especially in the direction of the cylinder axis. The plasticity of the inner layers being considerable on account of their higher temperature, these will partly yield, and the length of the cylinder after completely cooling will be somewhat less than before treatment. It is a necessary consequence that the diameter should simultaneously increase, as otherwise a successive increase in the specific gravity of the metal would occur. The result will be a growth of the middle part of the cylinder, together with a simultaneous shortening of its length; after repeated quenchings the cylinder will thus finally approach to a spherical form.

If, instead, the homogeneous cylinder is subjected to a very sudden heating, the outer parts must exert a certain stretching influence on the underlying portions, with a tendency to elongate the cylinder permanently and lessen the diameter of the middle part. As in this case the inner portions have a lower temperature, it is evident that the resulting elongation of the cylinder will be less than the shortening on sudden cooling. On the other hand, if the metal contains embedded particles which reduce its tensile strength, the possibility of the formation of cracks must be taken into consideration. The formation of cracks is an irreversible process: a specimen has a certain volume V; if at a certain stress cracks are formed therein, V will increase. If now the same stress be applied in the opposite direction, a volume V′ is obtained, which, under all circumstances, is greater than V. Cracks having once formed, do not vanish but always remain more or less; this is especially the case if the material in which the cracks have arisen is subjected to higher temperatures. In the case of a material in which cracks are easily formed, the following will occur. On account of the tensile stress exerted by the outer portions on the inner portion, on sudden heating, cracks may arise in the interior. On sudden cooling, however, cracks will arise, especially in the outer portions of the cylinder, on account of the stresses appearing there. As a matter of fact, the interior—even if already containing cracks—will offer a considerable resistance to compression, as explained above. Consequently, a series of sudden coolings will cause an increasing internal bursting or porosity, proceeding throughout the cylinder, and accompanied by an increase in volume. As this action is caused by the difference in expansion of adjacent layers of the specimen, it will, however, not be of any appreciable magnitude, except when the temperature changes take place very suddenly; the velocity of temperature change—and consequently of expansion—which may be attained by ordinary heating and cooling being rather insignificant, the phenomenon will be difficult to observe.

In the special case of material possessing an allotropic phase transformation point, at which a considerable anomalous change of length takes place, this must be equivalent, as regards its effect, to an extremely high speed of normal expansion or contraction. According to the previous statement, in a heterogeneous material possessing an anomalous dilatation point in which internal bursting may easily occur, repeated heatings above the transformation point with subsequent coolings will cause a sensible permanent increase in volume, and this even if the changes in temperature are made very slowly.

The primary cause of the growth of cast iron is to be found in the fact that—on account of internal bursting around the graphite lamellæ—the anomalous contraction at Ac decreases much more rapidly than the anomalous expansion at Ar. Every heating cycle consequently will give rise to a residual expansion, or growth. On account of this internal bursting a specimen,

when subjected to repeated heatings, will be the seat of "respiration"; and the oxidation brought about thereby will produce a considerable increase in the primary growth of the specimen.

Dr. H. C. H. Carpenter commented on the fact that the paper was entirely different from any which had previously been written on the subject. All the previous communications had contained experimental data upon which a theory had been constructed. The attempt of Dr. Benedicks and his colleague to construct a rational theory for the very complicated phenomenon which they had studied was one which entitled them to gratitude. As regarded the first of the ways in which the authors suggested that cast iron grew, viz., the change from Ac 1 to Ar 1 combined with internal cracking, it was very likely that that phenomenon took place, but in the work carried out by himself and Rugan, nothing of the kind was noticed. As a matter of fact, he regarded the evidence as conclusive that it was not necessary repeatedly to heat cast iron in order to get growth, and in that connection he quoted two remarkable instances mentioned by the late Dr. Stead during the discussion on the paper by himself and Rugan in 1911. Those instances, however, did not suggest, he said, that Professor Benedicks' theory was not right for cast iron repeatedly heated. The important point was that we might ultimately reach the same result by two different roads. The essential feature was oxidation. Few people realised the expansive force of oxidation in a metal at quite low temperatures unless they had worked at the subject. His own work had left him with an over-powering impression that oxidation was the main cause. A practical instance of the phenomenon was the difficulty of preventing the growth of retorts used in low-temperature carbonisation processes. There was no difficulty in getting a suitable iron to stand temperatures up to 625 deg. Cent., but it was a very difficult thing to get an iron to stand at 650 deg. Cent. The suggestion to use chromium was a very good one, and he happened to know that that metal was being used in preference to manganese in particular cases in which manganese had not proved suitable.

Dr. W. H. Hatfield said that Dr. Benedicks would find another test of his theory by plotting a curve of the effect of temperature on growth. If his theory were correct he should find a great increase in the growth coinciding with the critical point. He believed it would be very difficult to get the evidence required to establish the theory given in the paper.

Professor J. H. Andrew did not think it was possible to devise one theory to account for the growth of cast iron. There were probably more nearly twenty theories than one. Whilst at the moment he failed to see that the evidence supported the theory put forward in the paper, it might well be that it did apply to the case stated.

Mr. J. G. Pearce said that the influence of aluminium on iron-carbon alloys containing 3·5 per cent. total carbon was recently examined by Dr. Everest at the Birmingham University, and the results had been circulated to members of the British Cast Iron Research Association. The main result was to show that in the absence of silicon the iron-carbon-aluminium alloy was soft and machinable, with aluminium between 1 per cent. and 8 per cent. From 8 per cent. to 18 per cent. of aluminium the material was brittle, whilst above 18 per cent. and up to 25 per cent. aluminium the material was again machinable, a second graphitic range being demonstrated. Regarding the importance of oxidation, Mr. Pearce mentioned that he had examined some figures for the permanent growth of cast iron itself under conditions in which graphitisation was complete and under which oxidation would normally be comparatively slow. The increase of length found varied from four-fifths to twice as much as the amount indicated in the paper, the average of six samples being two-thirds in excess of the figure given by the authors.

Dr. Walter Rosenhain said that the authors had assumed that the cracks mentioned remained open. There was no real reason that he could see why the cracks should not close up again when the iron cooled He suggested that the experiments should be tried again in vacuo. There would not then be any question of oxidation. In the meanwhile Dr. Benedicks' theory would have to be regarded as a very interesting speculation, but he, for one, would not be surprised to find that it did not fit all the facts.

Time did not permit Dr. Benedicks to reply. The next paper was "The AC_1 Range in Special Steels," by Professor J. H. Andrew and H. A. Dickie. The object of the investigations described in this paper was to throw some light on the extent of, and the ractions involved in, the AC_1 range. The results arrived at do not lend themselves to summarisation. The only speaker in the discussion was Mr. J. A. Jones, who quoted the results of experiments carried out at Woolwich, which were largely in confirmation of the results given in the paper.

The final paper was "The Properties of Some Nickel-Chromium-Molybdenum Steels," by Professor Andrew, M. S. Fisher, and J. M. Robertson. The paper dealt with the properties of two series of nickel-chromium-molybdenum steels. In both series the percentages of chromium and molybdenum were constant, and the nickel increased from 2 to 5 per cent. In the first series the carbon content was constant at approximately 0·4 per cent.; in the second series the carbon content was approximately 0·8 per cent. The paper was divided into two main sections, the first dealing with thermal data, and the second with mechanical properties.

Mr. Jones was again the only speaker, and again referred to work done at Woolwich, which, he said, agreed in an amazing manner with the results given by the authors.

The remainder of the papers on the programme of the meeting were taken as read. These papers were as follows:—"The Manufacture of Steel in India by the Duplex Process," by B. Yaneske; "A Further Investigation of the Indentation Hardness of Metals," by K. Honda and K. Takahasi; "The Phenomenon of Temper-hardening in Steels," by T. Matsushita and K. Nagasawa; "Notes on Pseudo-twinning in Ferrite and on the Solubility of Carbon in Alpha Iron," by S. Tamura.

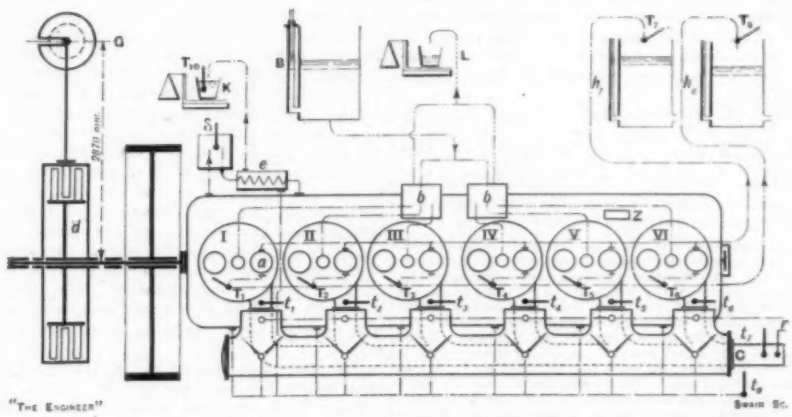
The meeting closed with a vote of thanks to the Institution of Civil Engineers for its kindness in allowing the Institute the use of its rooms.

A 1000 B.H.P. Airless Injection Marine Oil Engine.

No. II. (*Conclusion*)*.

PROFESSOR LANGER'S INDEPENDENT TESTS.

In the present article it is proposed to deal with a series of tests made on the Deutz 1000 B.H.P. marine oil engine, which was described and illustrated in our last issue. These tests partook of the character of independent trials which were carried out at the engine builder's works by Professor P. Langer, of the Technical High School at Aix-la-Chapelle. They were made with the object of investigating under conditions approximating to those in actual service, the heat distribution and the exact fuel consumption of the engine at varying loads. The trials were begun shortly after three o'clock on the afternoon of October 13th, 1926, and with a few minutes' intermission were carried through until one o'clock in the afternoon of the following day. The principal readings obtained and also the mean values are plotted to a time base in the upper diagram which we reproduce on the opposite page.



Description:—Nos. I. to VI., cylinder numbers; *a*, exhaust valve; *b*, fuel pumps; C, exhaust manifold; *d*, water brake; *e*, cooler for lubricating oil. *Measuring Points*:—B, fuel; L, by-passed fuel; G, load on brake; K, water for lubricating oil cooler; h_2 and h_3, water levels in measuring tanks for cylinder and exhaust valve cooling water; T_1 to T_{10}, temperatures of cooling water; t_1 to t_7, temperatures of air and exhaust gases; δ, temperature of lubricating oil; Z, speedometer; *r*, exhaust gas tester; —— · ——, cooling water circuits; —— · · · —— fuel circuits.

FIG. 6—DIAGRAM OF TESTING ARRANGEMENTS

THE TESTING ARRANGEMENTS.

The way in which the trials were carried out and the method of making the various measurements is illustrated in diagram Fig. 6. In order to provide the load a water brake designed by Professor Junkers, of Dessau, was employed. It was calibrated before the engine was started up. When running the trials the supply of water to the brake was hand regulated so that a constant brake moment was maintained for each load trial, which was run at practically constant engine speed. The several cylinders were indicated with one and the same indicator, and the indicator springs used were calibrated by weights on site. Up to 7.30 p.m. on the evening of the first day a marked variation of water pressure in the cooling circuit made it impossible to take a reliable reading of the amount of cylinder and valve cooling water which passed through the engine. For that reason it was not possible to follow the heat distribution in the engine from the moment of starting from cold, as had originally been planned. The cooling water was measured by nozzles and Poncelet vessels belonging to the laboratory of the Technical High School. There was only a small amount of oil cooler water to be dealt with, which was weighed. For measuring the fuel delivered to the engine a carefully filled and weighed vessel was employed. The vessel was used to fill up the fuel tanks during the trials, the fall in the oil fuel level being observed through a gauge glass. A certain amount of fuel oil, which was by-passed by the fuel pumps, was collected in buckets and weighed, while the cylinder lubricating oil was also similarly measured. It was not attempted to ascertain the actual amount of oil used in the general oil circulating system, as it was found to be exceedingly small and not of sufficient importance for the tests. Samples of the fuel used—which was gas oil—were taken and analysed in the Chemical Department of the Technical High School, and the oil was found to contain 86·5 per cent. of carbon and 12·65 per cent. of hydrogen and to possess a calorific value of 9822 calories per kilogramme or close upon 17,680 B.Th.U per pound. Mercury thermometers were used to measure the temperature of the exhaust gases, and they were placed—as will be seen from Fig. 6—directly in the exhaust passages of the cylinder covers. Each thermometer was housed in long metal sheathing tube which projected right to the centre of the exhaust passage, and which was furnished with slots so that the hot gases could reach the thermometer bulb, the stem of the thermometer being gripped by a suitably designed packing gland placed at the outer end of the sheath. The slotted sheath had the advantage of exposing the bulb of the thermometer to the current of hot gases, and at the same time it served to shield it from the cooling effect exercised by the exhaust passage walls. Experiments with closed and slotted sheaths showed that a totally enclosed thermometer sheath gave a reading which was some 15 per cent. too low. The thermometers employed were all calibrated and were found to be correct within the prescribed limits. During tests Nos. 3 and 4 samples of the exhaust gases were taken and they were analysed at a later date at the laboratory of the Technical High School. The results of the analyses are given in Table I., as also is the calculated volumetric efficiency of the engine, which was obtained from them.

THE TRIALS AND SOME RESULTS.

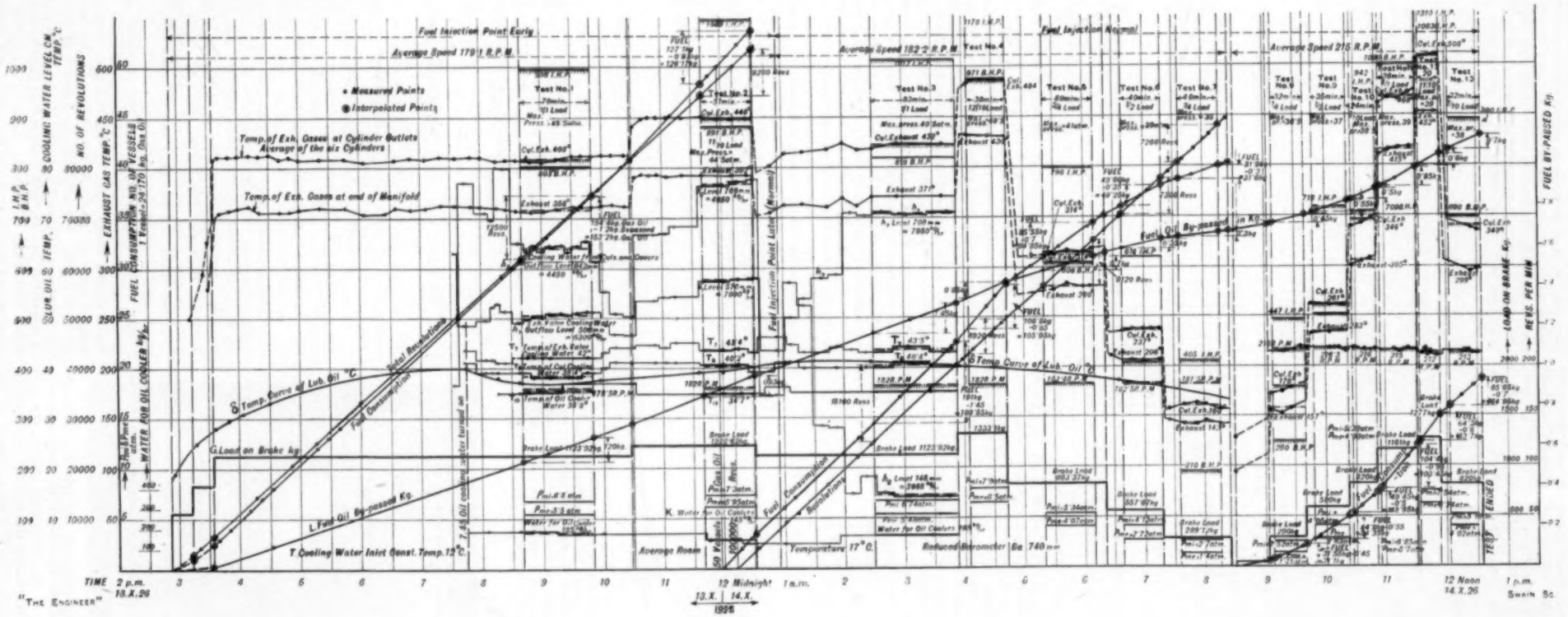
All the readings were taken and entered in a log by two engineers from the Engineering Laboratory of the Technical High School at Aix-la-Chapelle, namely, Dipl.-Ing. Merkle and Thomé, together with a laboratory assistant. The assistance given by the engine builder's own staff was confined to supervising the actual running of the engine and the regulation of the water brake. A graphical test diagram plotted on a time base, which we reproduce on the upper part of the opposite page, was employed for conducting the trials. Its use, Professor Langer claims, made it possible to carry out the trial with a smaller staff while the exact progress of any given test could at any time be noted; moreover, any particular period could be chosen in order to take a mean reading. In general, the system was found, it is stated, to be more flexible than those in which all measurements are taken together at a given signal, which are usually employed. The first trial with early fuel injection was run until about 1 a.m., after which time it was decided, at the request of a representative of the Deutz Motoren Fabrik, to retard the time of fuel injection so that the maximum pressure in the cylinders should not exceed about 40 atmospheres. That pressure, taking the continental technical atmosphere at 1 kilo. per square centimetre, or 14·223 lb. per square inch, works out at nearly 569 lb. Until 8.30 on the morning of October 14th the speed was maintained at 182 r.p.m. A stop of five minutes was then made in order to allow the water to run out of the brake so that the following 215 r.p.m. trial could be begun with the engine running light.

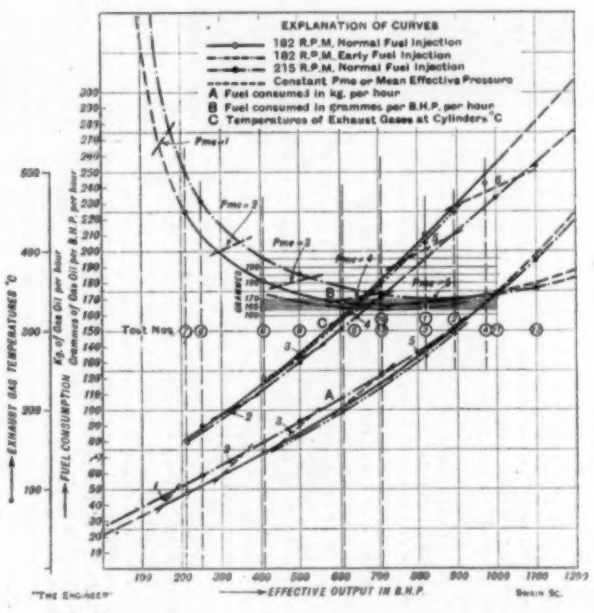
The main test results are given in graphical form in the curves† shown on page 545 and also in

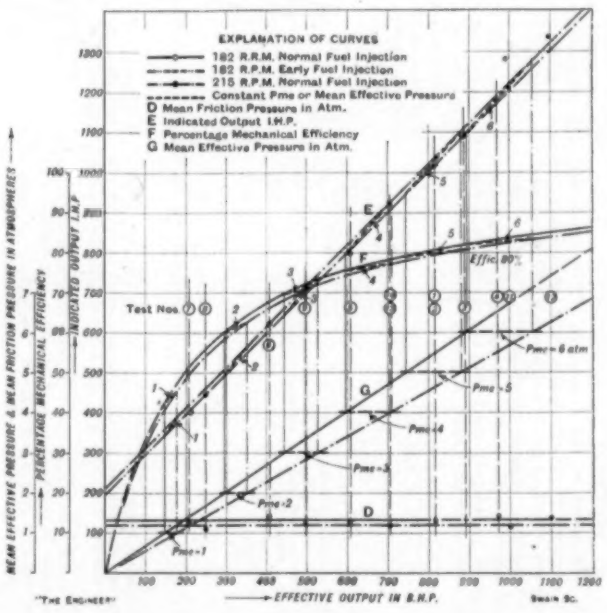
* No. I. appeared May 13th.

† The method adopted in drawing the curves is that described on page 14 and the following pages, of Professor P. Langer's and Dipl.-Ing. Thomé's book, "Anleitung zu Maschinentechnischen Messungen und Untersuchungen," published by the V.D.I. Verlag, Berlin, last year.

TEST CURVES OBTAINED WITH A SIX-CYLINDER AIRLESS INJECTION DEUTZ MARINE ENGINE


Fuel Injection Point Early
Average Speed 179 R.P.M.
Measured Points
Interpolated Points
Temp. of Exh. Gases at Cylinder Outlets Average of the six Cylinders
Temp. of Exh. Gases at end of Manifold
Fuel Injection Point Normal
Average Speed 182 R.P.M.
Average Speed 215 R.P.M.
Total Revolutions
Fuel Consumption
Auxiliary
δ Temp. Curve of Lub. Oil °C
G Load on Brake kg.
L Fuel Oil By-passed Kg.
T Cooling Water Inlet Const. Temp. 12° C.
Temperature 17° C.
Reduced Barometer Ba 740 mm
TIME
"THE ENGINEER"
Swain Sc.


EXPLANATION OF CURVES
182 R.P.M. Normal Fuel Injection
182 R.P.M. Early Fuel Injection
215 R.P.M. Normal Fuel Injection
Constant Pme or Mean Effective Pressure
A Fuel consumed in kg. per hour
B Fuel consumed in grammes per B.H.P. per hour
C Temperatures of Exhaust Gases at Cylinders °C
Test Nos.
EXHAUST GAS TEMPERATURES °C
FUEL CONSUMPTION Kg. of Gas Oil per hour Grammes of Gas Oil per B.H.P. per hour
EFFECTIVE OUTPUT IN B.H.P.
"THE ENGINEER"
Swain Sc.


EXPLANATION OF CURVES
182 R.P.M. Normal Fuel Injection
182 R.P.M. Early Fuel Injection
215 R.P.M. Normal Fuel Injection
Constant Pme or Mean Effective Pressure
D Mean Friction Pressure in Atm.
E Indicated Output I.H.P.
F Percentage Mechanical Efficiency
G Mean Effective Pressure in Atm.
Test Nos.
MEAN EFFECTIVE PRESSURE & MEAN FRICTION PRESSURE IN ATMOSPHERES
PERCENTAGE MECHANICAL EFFICIENCY
INDICATED OUTPUT I.H.P.
EFFECTIVE OUTPUT IN B.H.P.
"THE ENGINEER"
Swain Sc.

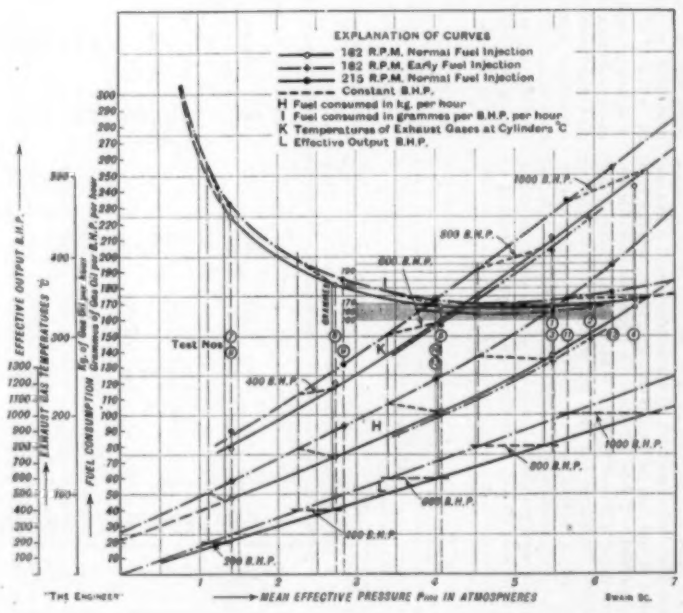

EXPLANATION OF CURVES
182 R.P.M. Normal Fuel Injection
182 R.P.M. Early Fuel Injection
215 R.P.M. Normal Fuel Injection
Constant B.H.P.
H Fuel consumed in kg. per hour
I Fuel consumed in grammes per B.H.P. per hour
K Temperatures of Exhaust Gases at Cylinders °C
L Effective Output B.H.P.
Test Nos.
EFFECTIVE OUTPUT B.H.P.
EXHAUST GAS TEMPERATURES °C
FUEL CONSUMPTION Kg. of Gas Oil per hour Grammes of Gas Oil per B.H.P. per hour
MEAN EFFECTIVE PRESSURE Pme IN ATMOSPHERES
"THE ENGINEER"
Swain Sc.

Table I. For the sake of convenience in comparison the speeds have been reduced to a basis of 182 and 215 r.p.m. respectively, whilst the fuel consumptions have also been reduced to correspond with a heating value of the fuel of 10,000 cal./kg., or 18,000 B.Th.U. per pound. Table II. shows a heat balance for the tests Nos. 1, 2, and 3, but it was not possible to obtain similar balances for the other tests owing to the variations in the flow of the cylinder cooling water, previously referred to. After the trials above referred to had been completed manœuvring tests were made, and it was shown that the engine easily started in

Table I.—*Test Results.*

Test No.	Load.	R.P.M. Meas'd.	R.P.M. Reduced	B.H.P. Meas'd.	B.H.P. Reduced	I.H.P. Meas'd.	I.H.P. Reduced	Total fuel oil, kg./hr. Meas'd.	Total fuel oil, kg./hr. Reduced	Fuel consumption. Grms. per B.H.P. per hr. Meas'd.	Grms. per B.H.P. per hr. Reduced to 10,000 k. cal per kg.	Lb. per B.H.P. per hr. Meas'd.	Lb. per B.H.P. per hr. Reduced to 18,000 B.Th.U. per lb.	Exhaust gas temperature. deg. C.	Mech. efficiency	Overall th'mal efficiency.	Analysis of exhaust gases. CO_2 %	O_2 %	CO %	Volumetric efficiency, %	Running conditions.
1	1/4	178·5	182	803	818	996	1017	131·2	133·9	164	161	0·360	0·354	408	80·6	39·4					Early fuel injection
2	11/10	182		891		1089		148·5		166·7	163·7	0·366	0·360	449	81·8	38·6					Mean speed, 179·1 r.p.m.
																					P max. at 1/4 load = 45·5 atm. or 647 lb./sq. in.
3	1/4	182		818		1012		137		167·5	164·5	0·368	0·362	422	80·8	38·5	5·6	11·8	0	89	
4	10/10	182		971		1178		167·3		172·3	169·2	0·379	0·372	484	82·4	37·4	7·3	9·6	0	89	Normal fuel injection
5	3/4	182·4		608		798		101·8		167·5	164·5	0·368	0·362	314	76·2	38·4					Mean speed, 182·2 r.p.m.
6	1/2	182·5		407		618		73·9		181·5	178·5	0·399	0·393	237	65·9	35·5					P max. at 1/4 load =
7	1/4	181·5		210		405		47·4		222·6	218·6	0·489	0·471	160	51·9	28·9					40·5 atm. or 576 lb./sq. in.
8	1/4	216	215	250	249	447	445	58·3	58	233	228·9	0·512	0·503	179	56·0	27·6					
9	1/2	216·3	215	502	499	718	714	93·8	93·2	186·8	183·5	0·411	0·403	261	69·9	34·5					Normal fuel injection
10	7/10	216	215	709	706	942	938	122·5	122	173	170	0·380	0·374	346	75·3	37·2					Mean speed, 215 r.p.m.
11	8/10	215		1000		1207		172·5		172·5	169·4	0·379	0·372	468	82·9	37·3					P max. at 1/4 load =
12	11/10	212	215	1083	1098	1310	1330	191	194·5	176·5	173·4	0·388	0·381	508	82·7	36·5					39 atm. or 554·7 lb./sq. in.
13	7/10	213	215	700	706	890	898	121·8	122·8	174	170·9	0·383	0·376	340	78·6	37					

forward and astern directions and that it continued to run regularly at the slow speed of 18 r.p.m.

Expansion Curve Exponents.

A calculation of the exponents of the expansion curves given by the indicator diagrams using the logarithmic method gave the following general results. The logarithmic diagrams exhibited a definite points, after which for all loads and speeds the exponents remained constant for the rest of the expansion stroke. The exponents so found, together with the points

Table II.—*Thermal Balance Sheets (Taken over One Hour).*

Test No. 1 : 1/4 Load, Early Fuel Injection, 178·5 r.p.m.

	Calories per hour.	Percentage.
To heat in fuel	1,289,000	100·0
By thermal equivalent of B.H.P.	507,500	39·4
By heat rejected in cooling water	311,000	24·2
By heat carried away in exhaust gases	428,000	33·2
By radiation, &c.	42,500	3·2
Total	1,289,000	100·0

Test No. 2 : 11/10 Load, Early Fuel Injection, 182 *r.p.m.*

	Calories per hour.	Percentage.
To heat in fuel	1,460,000	100·0
By thermal equivalent of B.H.P.	563,000	38·6
By heat rejected in cooling water	359,000	24·6
By heat carried away in exhaust gases	485,000	33·2
By radiation, &c.	53,000	3·6
Total	1,460,000	100·0

Test No. 3 : 1/4 Load, Normal Fuel Injection, 182 *r.p.m.*

	Calories per hour.	Percentage.
To heat in fuel	1,346,000	100·0
By thermal equivalent of B.H.P.	517,000	38·5
By heat rejected in cooling water	335,000	24·5
By heat carried away in exhaust gases	451,000	33·5
By radiation, &c.	43,000	3·2
Total	1,346,000	100·0

after which they remain constant, and the corresponding crank angles were marked on all the indicator diagrams. From these diagrams we have chosen three typical full-load diagrams for tests Nos. 1, 3, and 11, which are reproduced in Fig. 7. In Fig. 8 the actual exponents m obtained from the diagram are plotted in comparison with values for $K = C\,p/C\,v$, which have been calculated according to Holborn for the mean temperatures, and according to Langen for the upper and lower temperature limits. It is clear that the measured values are less than those calculated. If complete adiabatic expansion is assumed then it must follow that with the fall of temperature the magnitude of the exponent will increase as the stroke proceeds, and the heat carried away by the cylinder walls also points to an increase in the value of the measured exponent m compared with the calculated value $K = C\,p/C\,v$. If afterburning takes place the value of m will be reduced, but against such a suggestion must be taken into account the very low fuel consumption, the clear exhaust, and the comparatively low exhaust gas temperature. Further, it will be seen that it is at the higher speeds and also with overload, that the values of m and K tend to approach one another most nearly. Professor Langer suggests that the cause for the non-agreement of these values is to be found largely in the well-known delicacy of the operation of determining the exponent from the P V curve. How extremely delicate such an operation is, is shown by the fact that a lowering of the expansion line towards the end of the expansion stroke by an amount only equal to 0·16 mm., or less than the thickness of a line, gives full agreement between the measured exponent m and the calculated value of $K = C\,p/C\,v$.

If now the time during the combustion stroke which elapses between the passing of the top dead centre and the reaching of that point on the indicated expansion curve after which the exponent remains constant, be plotted in seconds to a base of fuel consumed per stroke per cylinder, then the common curve reproduced in Fig. 9 is obtained. Such a common curve would seem to show that both readiness of supply of fuel and the fuel distribution itself is equally good within this speed range. Nevertheless, the increased retarding of the combustion process in the expansion part of the stroke caused by the higher speed gives rise to the increased fuel consumption and the higher exhaust gas temperatures which were observed at the same mean effective pressure.

As a result of the relatively greater retardation in the spraying of the fuel at the higher speeds the maximum pressure in the cylinder, P max. was only 39 atmospheres at 215 r.p.m., whereas it reached 40·5 atmospheres at 182 r.p.m. with the same fuel injection setting. If the injection had only been

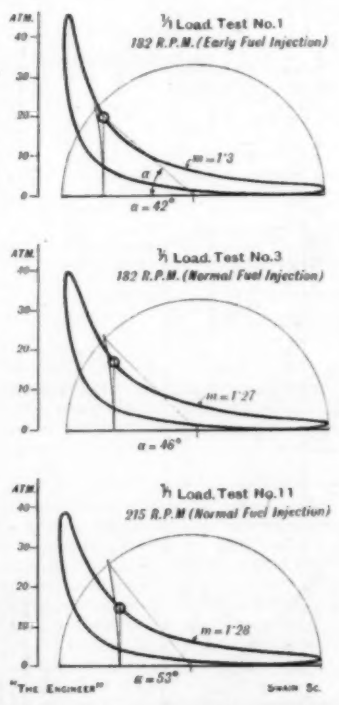


FIG. 7—TYPICAL FULL LOAD DIAGRAMS

slightly advanced a marked reduction in fuel consumption would have been achieved without raising the final pressure above 40·5 atmospheres, or 576 lb. per square inch.

Early and Normal Fuel Injection Compared.

It is interesting to compare the relative performances of the engine when working with early and with normal fuel injection. As previously stated, the fuel injection was retarded during the tests at the wish of the builders, as a concession, Professor Langer states, to the opinion largely held to-day that the constant pressure cycle is better than a mixed cycle in which constant pressure and constant volume working is combined. Professor Langer regards the tendency to adopt a high combustion pressure merely for the sake of obtaining combustion at constant pressure as wrong, a tendency which is to be looked upon as nothing more than a revival of the now abandoned idea of retarded combustion, which at one time was common in gas engine work. Constant pressure working must always be paid for by increased consumption of fuel. This in itself would not be so detrimental did not each heat unit of the extra fuel go to increase the heat stresses in the cylinder, piston, and valves of the engine. A part of the additional heat goes to warm up the cooling water, which is practically the same as raising the temperature of the cylinder liner and increasing the wear on the piston rings; what remains increases the exhaust gas temperature and thereby tends to the overheating of the exhaust valves.

It may be conceded that early fuel injection not only increases the final pressure in the cycle, but also the temperature; but it must be equally remembered that the period of duration of maximum temperature is scarcely one-hundredth of a second, which is hardly perceptible in the cylinder walls. As expansion proceeds the temperature falls rapidly below that which would be obtained with constant pressure working, and the mean cycle temperature for an engine working with early fuel injection is undoubtedly a lower one. In the same way that the point of maximum temperature is scarcely perceptible in the cylinder walls, so the point of highest pressure does not, on account of the mass of the piston, have any detrimental effect on the reciprocating parts, and in any case such an effect can quite easily be controlled.

The prejudice against indicator diagrams with a high-pressure peak may be accounted for, Professor Langer suggests, by past unfortunate experience with gas engines, which experience in the main was caused by high compression pressures giving a marked tendency towards back firing. In such cases, however, it was more probably the high temperatures obtained when compressing the mixture which led to cylinder trouble.

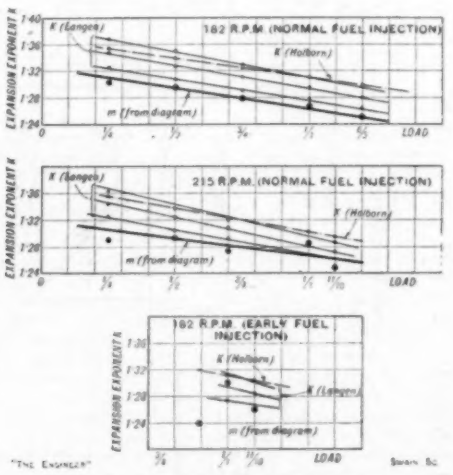


FIG. 8—EXPANSION CURVE EXPONENTS

One of the main reasons for the falseness of the theory of combustion at constant pressure is, Professor Langer states, the fact that the cycle is generally judged only by indicator diagrams, and no account is taken of the exhaust temperatures. It must be admitted that a nicely rounded diagram always has an appeal of its own, but it should equally be borne in mind that such a diagram fails to show the high exhaust gas temperature at the end of the expansion stroke, and this omission may often lead to false conclusions being drawn.

Referring to the heat balances for early and later fuel injection tests 1 and 3 given in Table II., it will be seen that out of the additional heat of 57,000 calories per hour about one-half goes to increase the

temperature of the exhaust gases 14 deg. Cent., whilst the other half is utilised in warming up the water in the cylinder jackets. Not in every case, however, does increased fuel consumption mean additional heat stresses in the engine. Exactly the contrary can take place when at the same load the engine is run faster with a correspondingly decreased mean pressure. One has to distinguish between a sound and unsound increase in fuel, the criterion for the sound condition being low exhaust gas temperatures and moderate cooling water temperatures in the jackets. Good running at increased fuel consumption is undoubtedly helped by working with a larger excess of air. Such excess serves to cool the engine internally, and while the heat content of the gases rejected from the cylinder is raised, lower maximum and mean cycle pressures and lower exhaust gas temperatures are nevertheless obtained.

The comparative figures given in Table III. give

TABLE III.—*Comparison of Slow and Fast Running Performances at* 818 *Constant B.H.P.*

R.P.M.	Pmo or mean effective pressure in atmospheres.	Fuel consumption, grammes per B.H.P. per hour.	Heat supplied in fuel, Calories per hour.	Mechanical efficiency, per cent.	Exhaust gas temperature, deg. Cent.	Heat rejected in exhaust gases, calories per hr.	Heat expended in friction and pump work, calories per hr.	Heat rejected in cooling water, radiation, &c., calories per hr.
182	5·50	167·5	1,346,000	80·8	422	451,000	122,600	378,000
215	4·65	170·5	1,370,000	79·4	390	470,000	133,300	Not measured
Additional heat utilised when running at 215 r.p.m.			24,000	= 19,000 + 10,700 − 5,700				

some information as to heat distribution for slower and faster running of the engine at a constant load of 818 B.H.P. Out of the additional 24,000 calories supplied to the engine when running at the higher speed 19,000 appeared in the exhaust gases, which, however, are at the lower temperature of 390 deg. Cent., compared with 422 deg. Cent. when the engine was run slower; 10,700 calories appeared as a frictional loss, and a less amount by 5700 calories than in the case of the slow-running engine was carried away to the cooling water and lost in radiation.

The general running of the engine at the higher speed was noticeably cooler on account of the increased excess of air, in spite of certain unavoidable retardation in the combustion which is caused by the higher running speed. It is shown to be advantageous to run the engine at higher speeds with a more moderate mean pressure rather than at slower speeds with higher mean pressures, even although the fuel consumption is thereby increased. This advantage continues so long as the retarding of the combustion process does not lead to afterburning and thereby

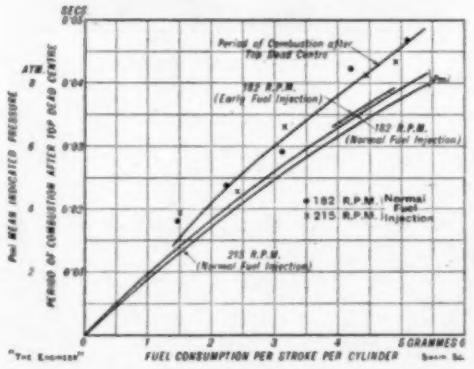


FIG. 9—COMBUSTION TIMES AND PRESSURES

cancels the gain in cooler exhaust gases, or again the high piston speed does not lead to undue piston ring wear. The retarding of the combustion at high speeds can be met by adopting earlier fuel injection.

Professor Langer's tests show that the performance of this relatively quite large airless injection engine is even better than that of smaller airless injection motors, both as regards its fuel consumption and its manœuvring capacity, also its reliability of working. The tests would seem to indicate that the upper limit for engines working with the airless injection principle has not yet been reached, and that a wide field is presented for the design and development of still larger units.

Coming at a time when great interest is being shown in the development of airless injection engines, Professor Langer's tests form an important addition to the literature on this interesting subject, and we would, in conclusion, express our thanks to the builders of the engine, the Motorenfabrik Deutz A.G., and Professor P. Langer, of the Technical High School at Aix-la-Chapelle, for placing these particulars at our disposal through Porn and Dunwoody, Ltd., of 72–78, Fleet-street, E.C. 4, who represent Deutz interests in Great Britain and in Ireland.

THE Groendal water scheme of the Uitenhage Town Council, South Africa, is estimated to cost more than £100,000.

Models for Demonstrating Electrical Principles.

WE are indebted to Dr. F. W. Alexander, of "Bankside," Ferry-road, Teddington, the late Medical Officer of Health to the Borough of Poplar, for particulars of some ingenious models he has invented for the purpose of teaching electrical principles. The model shown in Fig. 2 is for explaining the principle of alternating-current generators and consists of two parts—a rotor, capable of turning on a pivot, and a stator. Projections on the rotor represent the poles which may be painted alternatively red and blue to represent North and South poles, and between each projection, and upon the four sides, there is a coloured line indicating the direction of the current, according to the windings. By appropriate markings the electric current is also shown entering and leaving the rotor slip rings.

The circular stator may be made of cardboard or of other suitable material, such as celluloid, and upon the outer surface windings are painted in different colours, whilst the spaces between the windings are cut away in order to expose the rotor poles.

Above and below the diagrammatic windings, there are small red and blue areas, the same width as the magnets, and the top and bottom areas are of different colour, that is to say, the red is opposite the blue area and the blue area opposite the red. Each of these coloured areas is

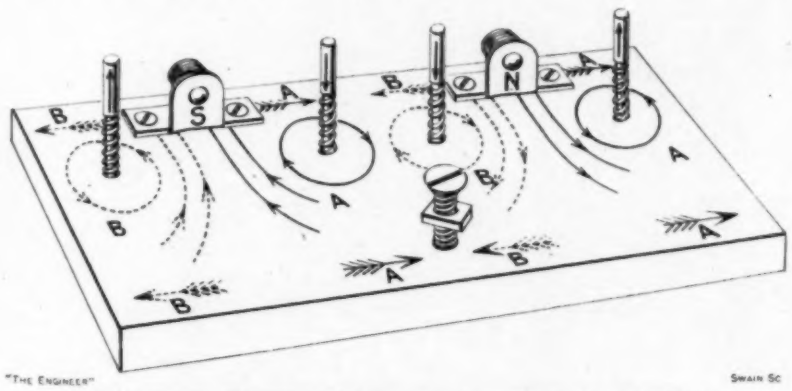


FIG. 1—MODEL SHOWING THE DIRECTION OF CURRENT IN CONDUCTORS

divided into two parts, and an arrow between them indicates, in accordance with well-known principles, the direction of the flow of the stator current, which is, of course, governed by the position of the rotor magnets. The coloured diagrammatic windings upon the stator are also marked with arrows corresponding to those on the upper and lower part of the model, which can be made to demon-

FIG. 2—ELECTRIC GENERATOR MODEL

strate the principle of single phase or polyphase generators by changing the diagrammatic windings.

Another model devised by Dr. Alexander is shown in Fig. 1, which is a sketch of a rough model he has sent us, the actual model being well finished and made in the form of a paperweight. It will be seen that there are four uprights mounted on a base, and behind these uprights there are imitation magnetic poles—a North and a South pole. The two uprights in front of the North pole are painted red, whilst those opposite the South pole are painted blue. By means of lines with arrows painted on the base, magnetic lines of force are shown emerging from the North pole and entering the South pole. Around each upright there is also a circle with arrows representing the magnetic field around the conductors, whilst on the conductors formed by the uprights arrows representing the direction of the current are painted. The four horizontal arrows represent the course pursued of the main magnetic field.

On the front of the base there is a screw with a nut, and by comparing the direction of a movement of this nut with the magnetic lines of force, as shown by the various arrows on the circles, the direction of current is found to correspond with the arrows marked on the uprights representing the conductors. If, for example, the nut is turned in the direction indicated by the arrows on the extreme left-hand circle, the nut rises on the screw thread corresponding with the direction indicated by the arrow on the extreme left-hand upright; whilst if the nut is turned in the opposite direction it naturally moves downwards on the thread corresponding with the arrow on the next upright. The movement of the nut will also be found to indicate the correct direction of the current when it is turned in the direction of the arrows on the circles surrounding the remaining two uprights in the vicinity of the North pole.

In the case of the paperweight model which is made by Beagley and Musto, of 2, Bedale-street, London Bridge, the nut is replaced by a grooved cylinder, which also turns on a screw thread, the principle being precisely the same as that described.

SIXTY YEARS AGO.

As a pendant to the leading article on the armament of capital ships which appears in this week's issue, we may give, from our issue of May 17th, 1867, some details of the gunnery performances and problems of the ironclads of those days. There had just appeared an Admiralty report on the trials of the Channel Fleet in 1866, a publication which we described as "the first official document containing reliable evidence as to the sailing and fighting qualities of our new fleet." The report was disheartening, for it showed that except in moderate weather the ships of the fleet would have been more or less powerless to molest our enemies. They were all broadside vessels, for the turret system, although warmly advocated by some authorities, had so far not been applied to anything except a monitor. Advantage had been taken of a gale on September 26th, 1866, to test the gunnery of the ships in rough weather. Each vessel was ordered to fire fifteen rounds in a heavy sea. None of the vessels, however, was rolling less than 10 deg. from the perpendicular. Some were rolling through 26 deg. or 28 deg., and one, the Pallas, was rolling through as much as 32 deg. Details were given of the measure of success attending the attempt to fire the guns of the Lord Clyde while that vessel was rolling through 26 deg. It was found quite impossible to fire at the target when the vessel was in any other position than head-on to sea, and even in that position the time occupied in firing the prescribed fifteen rounds was three-quarters of an hour. The main deck was flooded. The water flowed over the hatchways and poured into and out of the guns. Two shots rolled overboard out of the guns and one of them was followed by the cartridge. Two of the guns got the better of their crews, and banged in and out of their ports several times, with extreme violence. Three times the ship rolled her main chains right under and threw water on to her upper deck. The Admiral responsible for the report seems to have been justified in the conclusion which he reached that in an engagement fought in such weather "any guns which could have been got off would have hurt nobody." None of the other vessels of the fleet, with the single exception of the Achilles, behaved more satisfactorily than the Lord Clyde. The Achilles distinguished herself by her steadiness. While the Lord Clyde was rolling through 26 deg., she rolled but 12 deg. On another day, while the Lord Clyde was rolling through 10½ deg., the Achilles was rolling only through 2 deg. She was able to fire her guns in any position, even in the trough of the sea, when the other vessels hardly dared to open their ports. She could, in fact, in the gale of September 26th, have in all probability destroyed single-handed the whole of her consorts.

THE ROYAL AERONAUTICAL SOCIETY.—At the annual general meeting of the Royal Aeronautical Society, which was held on March 29th last, an alteration of the rule fixing the period of office for Chairman at one year, was altered to allow the Chairman to serve for two years, if such was the desire of the Council. Colonel the Master of Sempill, under this new rule, was unanimously elected by the whole Council chairman of the Society for a further period of office as from October, 1927, to September, 1928.

Large Mine Fan for the Durban Navigation Collieries.

A LARGE mine fan of the Sirocco type has been recently shipped by Davidson and Co., Ltd., of Belfast, to South Africa, to the order of the Durban Navigation Collieries, Ltd., of Natal. It is one of the most powerful fans that has yet been constructed, but, large as it is in size, it is not claimed to be the largest fan built, since many of the old type mine fans have exceeded it in diameter, though none of the latter and few modern mine ventilators approach the duty for which this Sirocco fan has been designed. Its comparatively small size is due to the multi-blade construction of the wheel, of which the Sirocco fan was the pioneer. The principle of this design has been maintained since its introduction, though great improvements, of course, have been made, both in constructional details and development of application.

The South African fan, which is illustrated in the accompanying engravings, is of the double inlet type, measures 12ft. 10in. in diameter and was designed to exhaust 700,000 cubic feet of air per minute against a resistance of 7in. water gauge, requiring 1030 B.H.P. on fan shaft. It is direct coupled to a Belliss and Morcom engine of 1200 H.P. and is intended to fulfil the duty mentioned when running at a speed of 200 R.P.M. The general arrangement of the fan is shown in the engraving Fig. 1, from which it will be seen that the wheel is mainly enclosed by brickwork except at the back. By virtue of the small fan diameter the total amount of brickwork,

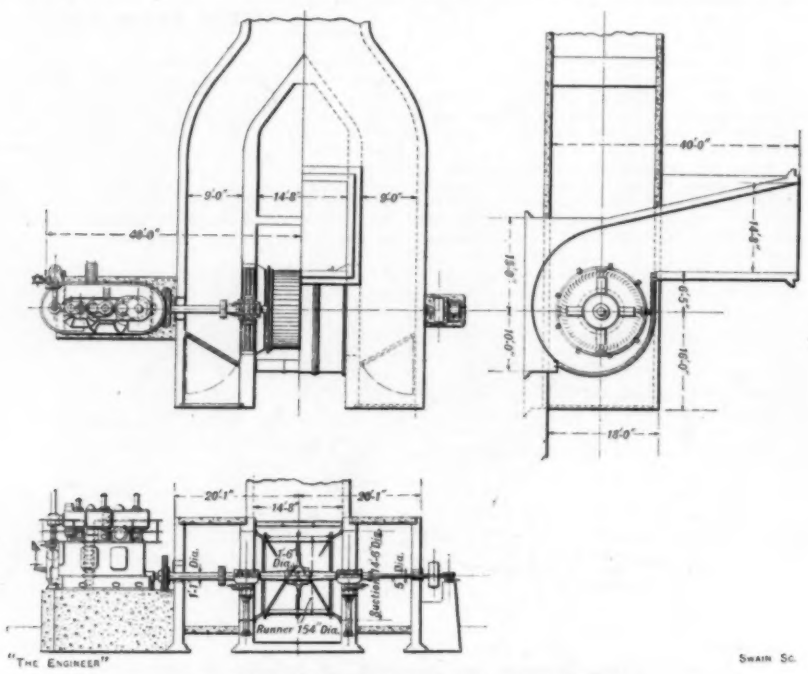


FIG. 1—ARRANGEMENT OF MINE FAN AND DUCTS

however, is much less than would be required for a larger diameter fan of the paddle-wheel type for the same duty. Shaped mild steel sheets, ¼in. thick, are used to form the *évasé* discharge, while the base is stiffened by specially shaped angles. The air is led to the wheel through two conical suction inlets, which are bolted to the brickwork.

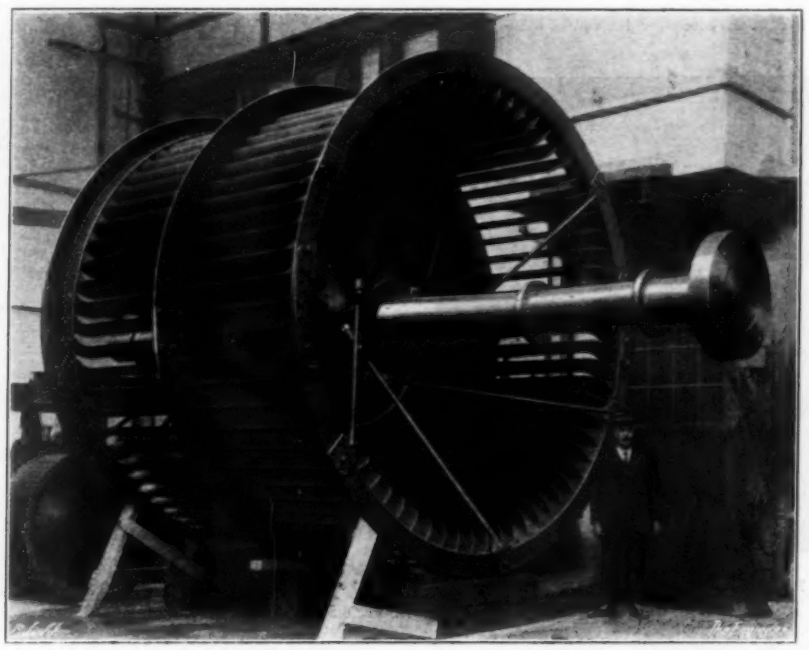


FIG. 2—WHEEL OF SIROCCO MINE FAN

The wheel—Fig. 2—is, as will be observed, of the usual "Sirocco" multi-blade construction, the blades being made of specially selected mild steel, ¼in. thick, riveted back of the fan casing, and these sheets are well braced with angles and tees, and are provided with spiral angles attached to the brick sides of the fan casing. A compound girder at the top of the casing carries the weight of the to a circular steel plate, which is in turn riveted to a cast iron disc 7ft. 6in. diameter. The weight of the complete wheel is approximately 10 tons.

The shaft—Fig. 3—which is in two lengths, is 13in. in diameter, but swelled to 18in. in the centre to take the boss of the fan wheel. Combined oil throwers and thrust collars are forged solid with the shaft, which weighs about 7 tons and is 32ft. 6in. long. The two parts of the shaft are connected by a solid coupling, and a similar coupling is employed between fan shaft and engine.

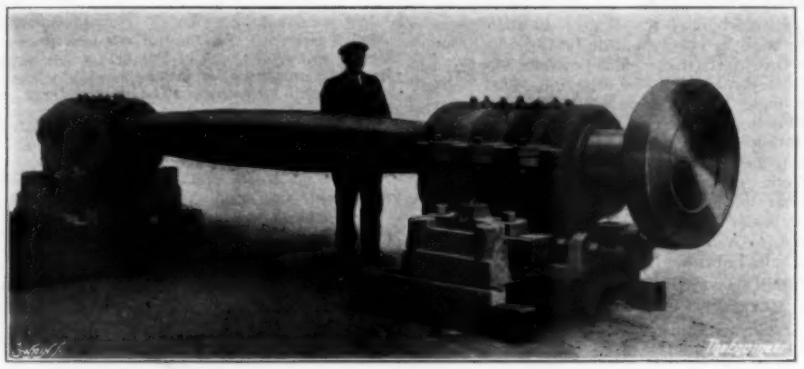


FIG. 3—SHAFT OF FAN WHEEL

The reliability of a mine fan being very largely dependent upon the design of the bearing, it is only to be expected that the most careful attention has been paid to that part of the machine. The complete bearing, of which there are two, is illustrated in Fig. 4. Each weighs 2 tons and is 13in. in diameter and 42in. long. They are of the ring-lubricated type, are constructed of cast iron with separate cast iron bushes lined with white metal, and recessed ends are provided to accommodate the solid forged collars on the shaft. The bearing ends are fitted with cover plates and leather washers, so as to make them practically oil-tight and dustproof, and the oil reservoir is large enough to

FIG. 4—FAN SHAFT BEARING

hold sufficient lubricant for about a month, if necessary. An adjustable sole plate, shaped like a wedge, which raises the bearing the further it is screwed in, is provided under each bearing, and furnishes a ready means for adjusting the alignment of the shaft. This sole plate is also particularly useful when the lower bush has to be removed, in which case the plate is withdrawn, allowing the lower half of the bearing to drop and the bush to be slipped round the shaft without necessitating the employment of tackle. Fig. 5 shows the bearing with the cap and upper bush removed. The bearings are carried by girders built into the sides of the fan casing and supported in the centre by cast iron pillars.

The engine which will operate the fan is of the three-crank triple-expansion type, built by Belliss and Morcom,

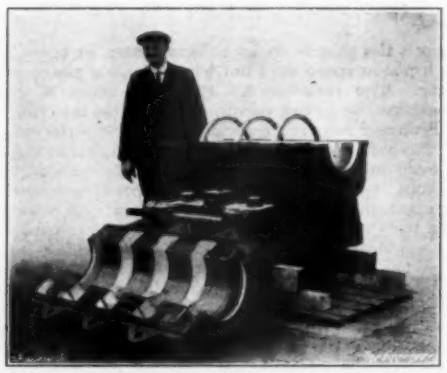


FIG. 5—BEARING WITH CAP REMOVED

Ltd. It has a normal rating of 1050 B.H.P. at 202 R.P.M. and a maximum rating of 1200 B.H.P. at 212 R.P.M. with steam at 160 lb. pressure per square inch. The cylinders, which are 20in., 27in., and 43in. respectively in size, with 20in. stroke, operate cranks set at equal angles so as to ensure even turning and freedom from vibration. The governor operates on the spring drive principle, and is designed so that the engine will run at any speed between 135 and 212 R.P.M. The bearings throughout, including the working joints of the governor, are lubricated on the forced lubrication principle, two oil pumps being supplied, each capable of maintaining the oil supply of the engine. Metallic packing is fitted to all the piston and valve rod

stuffing-boxes. Self-adjusting scraper rings of special design—equivalent to so many additional sets of metallic packings—are fitted in the casing stuffing-boxes to keep down the oil and prevent water passing down into the crank chamber, there being no soft packing used in connection with these or with the cylinder stuffing-boxes. The engine is fitted with a sight-feed lubricator, having a separate pump to each of the eight feeds.

The levers for working the drain cocks, pass valve hand wheels, governor adjusting gear, as well as the tachometer and pressure gauges, are all brought together in close proximity to the engine stop valve, so that the engine can be handled by one man from the one starting position. Provision is made for warming up the engine by passing the steam through all the cylinders, low pressure included. A small by-pass valve is fitted for this purpose and to facilitate starting the engine. There is a complete system of drain pipes leading from the top of the casing into a side pocket in the bed-plate, with a device for automatically separating the oil and water which pass down, returning the oil to the crank chamber and rejecting the water to waste. A distance in excess of the full stroke of the piston is allowed between the cylinder and casing stuffing-boxes to guard against the possibility of oil being carried up into the steam cylinders. The engine is fitted with a steam separator to dry the steam and act as a capacity reservoir to reduce pulsations in the pipe line.

It will be observed from the drawing that there is a light shaft extension to the fan shaft. This shaft, which is fitted with a pulley and carried in an outboard bearing, is intended for driving an emergency dynamo.

Resuscitating a Somerset Quarry.

IN the Wellington district of Somerset, or, to be precise, just by Holcombe Rogus, there are some limestone hills which have been quarried from time immemorial for lime

FIG. 1—PONDGROUND QUARRY

for burning, and the hillsides are dotted with the remains of old kilns, while there are vast dumps of the material which was thrown out by the old workers as being unsuitable for the production of lime. For many years these quarries have been more or less derelict, probably on account of the decay of the once flourishing local industry of chair making and the consequent reduction of building programmes, while the reduction in the use of lime in agriculture during the last half century must have had a corresponding effect. A new use for the stone has, however, recently developed in the provision of road metal, for which there is a large demand locally and for some distance around, on account of the road improvement schemes now being carried out.

In the circumstances Mr. H. J. Howe, of Greenham, purchased the old Pondground and Beacon Hill quarries and has installed modern equipment, with the object of producing economically a considerable amount of broken road metal. At his invitation we recently spent a day touring round the quarries and incidentally witnessed the official starting up of the new plant.

The Pondground quarry, of which we give a fragmentary illustration in Fig. 1, is alongside the lane leading to Greenham, and is close to the Great Western Canal, with which it was once connected by a tunnel beneath the lane. The tunnel has, however, been filled in, and it is doubtful if it would be worth reopening it, as the canal itself is virtually derelict. Mr. Howe has, however, a fleet of petrol lorries with which to distribute the product.

It is noteworthy that the face of the quarry is exceptionally clean—it can be seen in the background of our view—and comprises solid rock for a height of some 90ft., with only a few inches of soil as overburden at the top,

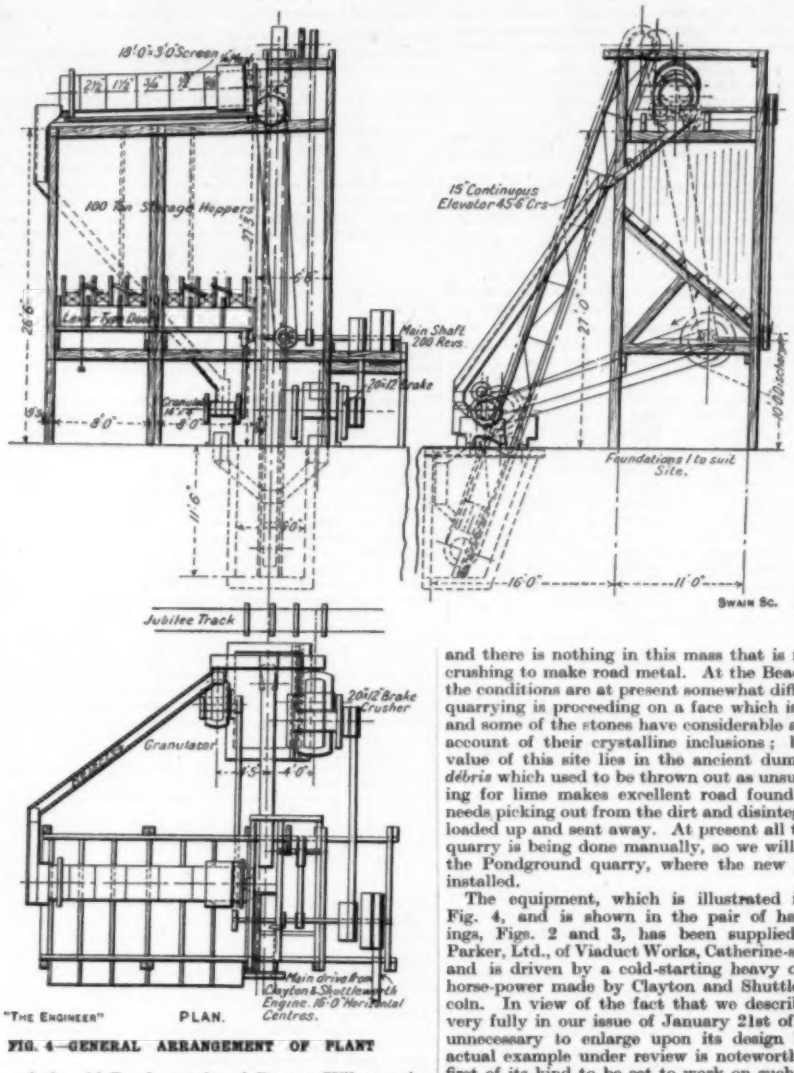


FIG. 4—GENERAL ARRANGEMENT OF PLANT

FIGS. 2 AND 3—STONE CRUSHING AND SCREENING PLANT

and there is nothing in this mass that is not suitable for crushing to make road metal. At the Beacon Hill quarry the conditions are at present somewhat different. Normal quarrying is proceeding on a face which is much faulted, and some of the stones have considerable artistic value on account of their crystalline inclusions; but the present value of this site lies in the ancient dumps. The flinty *débris* which used to be thrown out as unsuitable for burning for lime makes excellent road foundation and only needs picking out from the dirt and disintegrated material, loaded up and sent away. At present all the work at this quarry is being done manually, so we will concentrate on the Pondground quarry, where the new plant has been installed.

The equipment, which is illustrated in the drawing Fig. 4, and is shown in the pair of half-tone engravings, Figs. 2 and 3, has been supplied by Frederick Parker, Ltd., of Viaduct Works, Catherine-street, Leicester, and is driven by a cold-starting heavy oil engine of 55 horse-power made by Clayton and Shuttleworth, of Lincoln. In view of the fact that we described this engine very fully in our issue of January 21st of this year, it is unnecessary to enlarge upon its design here; but the actual example under review is noteworthy as being the first of its kind to be set to work on such a service. On the occasion of our visit the engine had been out of the erector's hands scarcely a fortnight, but the engine-house was as tidy as one could wish, the engine started immediately from cold and picked up the load readily with the assistance of fast and loose pulleys in the main drive. In the country lane immediately alongside the engine-house the running of the engine was hardly perceptible.

The Parker plant comprises a large stone crusher, an elevator, an overhead screen, a smaller crusher for the rejects, a set of hoppers and a winch for hauling the stone out of the quarry. All this plant is driven by a single belt from the Clayton engine.

On reference to the drawing it will be seen that there is a main shaft running at 200 revolutions per minute in the main framework from which the various units are driven by separate belts. The greater part of the framework was, by the way, built of timber felled on the site, and some idea of the age of the workings may be gathered from the fact that hardwood trees a foot and a-half or so in diameter, which were growing in the old lime kilns, were felled for their timber.

In describing the plant it may be best to follow the stone on its route from the quarry, where it is loaded into jubilee wagons at the face. These wagons, which hold about a cubic yard each, are hauled up a slight incline to the plant by means of a simple friction winch and wire rope, which is driven from the main shaft. This winch stands alongside the large crusher, but is not shown in our drawing. The stone is dumped into a shoot and gravitates into the main crusher, which is of the Blake jaw type and has an opening 20in. by 12in. This form of crusher is so well known that it is unnecessary to describe it here, but it may be mentioned that the jaw stock is of cast steel, while the jaws themselves are of manganese steel. The output of the machine is 11 tons of road metal per hour and it requires about 24 horse-power. The broken stone falls into a deep concrete hopper, which forms the boot of an elevator for raising it to the overhead screen. The elevator is 45ft. 6in. between centres and has overlapping buckets 15in. wide made of $\frac{1}{4}$in. steel plate. The buckets are attached to a steel bushed chain and each one has a transverse skidder bar which runs in an angle iron on either side to steady it both in ascent and descent. These bars can be very easily renewed when worn. The elevator is driven at the upper end through a 6 to 1 speed reduction gear, while there is a tension adjustment gear at the lower end.

The elevator delivers the broken stone directly into the screen, which is mounted on the top of a timber structure. The screen is 18ft. long by 3ft. in diameter, and is supported at either end by a ring running on a pair of rollers. At the front end the rollers are driven, through bevel gearing and thus rotate the screen. It is perforated with holes $\frac{3}{4}$in., $\frac{1}{2}$in., $\frac{3}{8}$in., $1\frac{1}{4}$in. and $2\frac{1}{2}$in., in diameter, while

there is a jacket of ¼in. in mesh woven wire over part of the first section for the elimination of "smalls." Below each section of the screen there is a separate compartment of the hopper, which has a total capacity of about 100 tons. We noticed, looking down into the hoppers, that the screen was evidently working effectively, and that each grade was well separated. Any rejects which will not pass through the perforations fall out of the end of the screen, down a long shoot plainly shown in the half-tone engravings, to a small granulator or crusher, with 14in. by 4in. jaws. This machine breaks up the lumps to small size and drops them into the boot of the elevator, so that they go to the screen again.

The storage hopper is a simple affair, built up of railway sleepers and steel joists on two concrete walls, and is provided with steel drop doors for running the stone into wagons beneath. There is accommodation for loading two wagons at once, and it only takes about four minutes to load up 5 cubic yards.

It is noteworthy that throughout its journey from the quarry face the stone does not require to be man-handled, and that the plant requires a minimum of attention—we believe that had it not been for our request to get a close view of the screen, no one would have gone to the top platform all day long. The plant, it will be noticed, has not been roofed over so far, but it is Mr. Howe's intention to enclose it entirely in order, for one reason, to prevent dust blowing about.

The capacity of the plant is guaranteed by the makers to be 11 tons an hour; but on the occasion of our visit it was doing nearer 15 tons, and that was on a day when the men were celebrating the opening. With everything running normally, we should expect an output of 120 tons a day. Another matter which may help towards an increased output is the proposal to use some of the compressed air provided for starting the engine for working pneumatic drills at the quarry face.

Altogether, the plant seems to us to be a good example of the economies which can be effected with the aid of modern machinery. Incidentally, it had a peculiar local advantage during erection, as the machinery was got into place with the assistance of a wire rope stretched overhead between two tall trees, so that no derrick was needed even for loads of 2 tons. This rope can be seen just above the screen in one of our engravings.

Results Obtained with High-pressure Steam at Langerbrugge Power Station.

THE Langerbrugge power station of the Centrales Electriques des Flandres is famous for the use of steam at a pressure and temperature far in advance of ordinary practice. The steam temperature employed, namely, 840 deg. Fah., is indeed higher than that at any other power station in the world, and the boiler pressure of 800 lb. per square inch is almost equally notable. Up to the present, very little information indeed has been available as to the working results of extra high-pressure steam, although the recent decision to make large extensions to the Langerbrugge plant on the same lines has demonstrated that the owners of the station are themselves perfectly satisfied with the results obtained. The first official information concerning the performance of this plant was given by Monsieur L. Herry in a report presented by him to the Rome Congress of the International Union of Producers and Distributors of Electricity, and in view of the great interest taken by engineers in the Langerbrugge station, we reproduce some of the principal figures below. To follow them intelligently it is necessary to know the equipment

TABLE I.—*Tests of Low-pressure Turbine, July 1st, 1925.*

Duration of test, 3.15 p.m. to 4.15 p.m.	1 hour
Average steam pressure	18·8 kilos. per cm².
Average steam temperature	319·0 deg. Cent.
Revolutions of turbine	3000 per min.
Vacuum	720 mm.
Temperature of exhaust	34 deg. Cent.
" condensate	34 deg. Cent.
" inlet circulating water	19 deg. Cent.
" outlet circulating water	29 deg. Cent.
Voltage of alternator	12,000 volts
Power factor	Unity
Output measured by precision wattmeter	6459 Kwh.
" " integrating meter	6500 Kwh.
Mean reading of switchboard watt indicator	6100 Kwh.
Weight of condensate	32,785 kilos.
Steam per kWh.	5·075 kilos.
Steam per kWh., corrected to designed-conditions	4·983 kilos.

of the station. As the latter was fully described in our issue of June 4th last year, we need now only give briefly a few of the leading particulars.

The station contains altogether nine boilers of the "B. & W." marine type, equipped with chain grate stokers. Three of these boilers, each with a normal evaporative capacity of 26,400 lb. per hour, generate steam at 800 lb. per square inch and at a temperature of 840 deg. Fah. The other six, of which four have a normal capacity of 33,000 lb. per hour and two of 50,600 lb. per hour, generate steam at 285 lb. pressure and 620 deg. Fah. In the engine-room there are four turbo-generators, with a capacity of 6600 kilowatts each, designed to work with steam at the lower pressure. There is, in addition, a high-pressure geared turbo-generator rated at 1600 kilowatts, designed to work with steam from the high-pressure boilers, and to exhaust against a back pressure equal to that of the main steam range. In ordinary operation the steam leaving this high-pressure turbine passes directly into the main steam range, which serves all the low-pressure turbines. It is, however, possible to confine the high-pressure exhaust to one of the low-pressure turbines, the latter then receiving no steam other than that which has previously done work in the high-pressure turbine.

In Table I. is given the result of a test of one of the low-pressure 6600-kilowatt turbines, carried out on July 1st, 1925. We reproduce the figures in their original form, for so many engineers now use the Centigrade thermometer, and there is such a conflict of opinion as to whether the B.Th.U. or the pound-calorie should be used as the unit of heat, that it seems better to leave the reader free to make any conversion which he may desire in it and in the following tables.

Table II. gives the results of tests of the high-pressure installation, carried out on three different days. The run on February 24th was made with the high-pressure turbine exhausting into a separate steam range, from which a low-pressure turbine was supplied, the high-pressure plant and the low-pressure turbine being thus isolated from the rest of the station. The total electrical output of the two turbo sets aggregated 78 per cent. of the rated capacity of the machines. The next test, that carried out on March 3rd, 1926, was made with the high-pressure turbine exhausting into the common steam range in which the pressure was maintained at 20 kilos. per square centimetre by the low-pressure boilers. In this case the low-pressure turbine took more steam than was delivered by the high-pressure turbine, and the machines together developed 93·4 per cent. of their rated capacity. During the third test on March 8th, the high-pressure turbine and low-pressure turbine were isolated, as in the first test. The aggregate output on this test was 53·8 per cent. of the rated capacity of the machines.

In addition to the tests tabulated above, Mr. Herry gave in his report a summary of the results of the operation of the plant for a week under ordinary conditions of load. During that week the high-pressure turbine was run in conjunction with one of the low-pressure turbines, and this combination is referred to in Table III. as the "high-pressure plant." The "low-pressure plant" comprises the turbines using live steam at 20 kilos. pressure and the boilers serving them.

It will thus be seen that the high-pressure plant showed a fuel economy varying from 32 to 37 per cent., as compared with the results obtained from steam at the lower initial pressure and temperature. All power station engineers will congratulate Mr. Herry on the success which has attended his pioneer work in the use of steam at high pressures and temperatures, and will look forward with the greatest interest to the performance of his station when the new extensions are completed. These will comprise a turbine of 6600-kilowatt capacity, supplied with steam from three new boilers, each with a normal evaporation of 99,000 lb. of steam per hour at a pressure of 800 lb. per square inch, superheated to 840 deg. Fah. When these are installed, the whole station will be "compounded," as the three turbines which now run with live steam at 285 lb. pressure will then be operated by steam generated at 800 lb., after it has passed through one or other of the high-pressure turbines.

TABLE II.—*Results of Tests of High-pressure Plant.*

		Dates of tests.		
		24.2.26.	3.3.26.	8.3.26.
Length of test, hours		5	5	4
High-pressure turbine—Admission temperature of steam, deg. Cent.		445	443	444
Admission pressure of steam, kilos. per sq. cm.		47·4	49·0	53·5
Exhaust pressure of steam, kilos. per sq. cm.		16·5	20·7	11·4
Exhaust temperature of steam, deg. Cent.		318·5	331·0	314
Low-pressure turbine—Admission temperature of steam, deg. Cent.		307	318	300
Admission pressure of steam, kilos. per sq. cm.		16·0	19·7	11·2
Exhaust temperature of steam, deg. Cent.		25·22	28·7	21·0
Temperature of feed water, deg. Cent.		170·9	179·5	158·6
Weight of high-pressure steam used, kilos. per hour		32,244	33,720	23,300
Weight of low-pressure steam used, kilos. per hour		—	7,100	—
Make-up feed water, per cent.		7·35	6·0	5·25
Calories per kilogramme of high-pressure steam, calories		788·5	786	786·5
Calories furnished to turbines by high-pressure boilers, calories		$25·4 \times 10^6$	$26·4 \times 10^6$	$18·3 \times 10^6$
Calories per kilogramme of low-pressure steam, calories		—	732	—
Calories from low-pressure boiler to low-pressure turbine, calories		—	$5·18 \times 10^6$	—
Total calories supplied, calories		$25·4 \times 10^6$	$31·58 \times 10^6$	$18·3 \times 10^6$
Weight of water per hour to high-pressure boilers, kilos.		34,800	35,880	24,550
Calories returned to high-pressure boilers, calories		$5·95 \times 10^6$	$6·45 \times 10^6$	$3·9 \times 10^6$
Weight of water per hour returned to low-pressure boilers, kilos.		—	7,560	—
Calories per kilogramme of water, calories		—	27	—
Calories returned to low-pressure boiler, calories		—	204,000	—
Total calories returned to boilers, calories		$5·95 \times 10^6$	$6·654 \times 10^6$	$3·9 \times 10^6$
Calories used by the turbines, calories		$19·45 \times 10^6$	$24·926 \times 10^6$	$14·4 \times 10^6$
Load on high-pressure turbo-generator, kilowatts		1,600	1,385	1,085
Load on low-pressure turbo-generator, kilowatts		5,000	6,415	3,45)
Consumption of motor-driven pumps, kilowatts		150	150	130
Useful kilowatts supplied, kilowatts		6,450	7,650	4,495
Useful energy in calories, calories		$5·53 \times 10^6$	$6·47 \times 10^6$	$3·78 \times 10^6$
Efficiency of turbo-generators, per cent.		28·5	26·4	26·3
Calories per kilogramme of steam leaving boilers, calories		792	794	792
Calories supplied by boiler per kilogramme water, calories		621	614·5	633·4
Calories supplied by high-pressure boilers, calories		$21·6 \times 10^6$	$22·0 \times 10^6$	$15·5 \times 10^6$
Weight of coal burnt per hour, kilogrammes		4,507	4,130	3,225
Lower calorific value of coal, calories per kilogramme		6,440	6,900	6,458
Calories supplied to high-pressure boilers, calories		$29·0 \times 10^6$	$28·4 \times 10^6$	$20·8 \times 10^6$
Overall thermal efficiency of high pressure plant, per cent.		19·1	23·1	18·8
Steam consumption per kilowatt-hour, kilogrammes		5·4	4·7	5·57
Coal consumption per kilowatt-hour, kilogramme		0·708	0·540	0·735

TABLE III.—*Operating Results for the Week ending May 15th, 1926.*

	Monday.	Tuesday.	Wednesday	Thursday (holiday).	Friday.	Saturday.
Total daily output, kilowatt-hours	161,700	167,600	168,000		164,400	137,200
Output.—Low-pressure plant, kilowatt-hours	97,100	104,200	102,000	50,500	100,000	100,800
High-pressure plant, kilowatt-hours	64,600	63,400	66,000		64,400	36,400
Average coal per kilowatt-hour, kilogramme	0·726	0·715	0·771		0·721	0·787
Coal per kilowatt-hour.—Low-pressure plant, kilogramme	0·840	0·860	0·860	1·033	0·822	0·875
High-pressure plant, kilogramme	0·535	0·543	0·540		0·566	0·570
Average calories per kilowatt-hour, calories	5,040	5,010	5,030		5,060	5,520
Calories per kilowatt-hour.—Low-pressure plant, calories	5,890	5,680	6,030	7,030	5,760	6,060
High-pressure plant, calories	3,760	3,810	3,790		3,880	4,010
Difference in calories, calories	2,130	1,870	2,240		1,880	2,050
Percentage difference in calories, per cent.	36	33	37		32·5	33·8
Average calorific value of coal, calories	7,000	7,000	7,000	7,000	7,000	7,000

PISTON RINGS FOR AUTOMOBILES.

THE British Engineering Standards Association has just issued revised editions of the following B.S. specifications:—No. 5003, 1927, "Wide Type Concentric Piston Rings for Automobiles"; No. 5004, 1927, "Cast Iron Piston Ring Pots for Automobiles"; and No. 5023, 1927, "Narrow Type Concentric Piston Rings for Automobiles." The principal alterations made to the specifications are as follows:—The chemical composition of the piston ring pots has been modified to bring it into line with the current practice for automobile work. In the piston ring specifications the minimum and maximum E_a values of $13\frac{1}{2} \times 10^6$ and $15\frac{1}{2} \times 10^6$ lb. per square inch respectively have been adopted in place of a minimum value of 12×10^6 lb. per square inch to correspond with present-day practice. Owing to certain misunderstandings which have occurred in connection with the use of the previous specification, the clause on the formulæ for cylinder wall pressure and maximum stress has been re-worded and amplified, and guidance is given as to the method of calculating the minimum and maximum wall pressures and the theoretical stresses in the rings. The table of dimensions has been enlarged to include both minimum and maximum cylinder wall pressures, based on a nominal free gap of three and a half times the minimum thickness of the rings.

Copies of these revised specifications may be obtained from the Publications Department, British Engineering Standards Association, 28, Victoria-street, London, S.W. 1, price 2s. 2d. each post free.

CANADA will this summer initiate experimentally her first air mail service. It will be run between Rimouski, on the lower St. Lawrence, where liners take on pilots, and Montreal.

Railway Matters.

THE up morning Scottish express by the Midland route was involved in a collision with a light engine at Sheffield on Saturday last.

THE London and North-Eastern opened on the 2nd inst. a traffic control office at King's Cross, which operates for the line between that station and Grantham and its branches. There are 130 places on the telephone board.

THE Welland Railway, one of the oldest lines in Canada, a connecting link between Lake Ontario and Lake Erie, which was taken over by the Canadian National Railways, has ceased to operate. The service has been taken over by the electric lines of the Niagara St. Catharines and Toronto Railway.

IN view of the fact that the weekly traffic returns now compare with the period of the coal stoppage, the railway companies are giving the corresponding figures for the normal year of 1925, as well as those of a year ago. Whilst there have been coal stoppages in previous years, *e.g.*, in 1921, this is the first time such additional information has been given. With the grouping of the companies more matters of that kind can be arranged, and it, of course, is to the railways' benefit that it should be known how they suffered last year.

IT was announced by Colonel Ashley, the Minister of Transport, in the House of Commons, on the 10th inst., that it was hoped that the "appointed day" on which, under the Railways Act, 1921, the new standard charges are to operate, will be January 1st next. Speaking subsequently Mr. Gosling, Colonel Ashley's predecessor when the Labour Government was in power, congratulated the Minister on the volume of work which had been done by his department. It was, said Mr. Gosling, all the more satisfactory because most of it was real business and not politics.

ACCORDING to the recently published statistics for February last there was, when compared with February, 1926, a decrease of 8·6 per cent. in the number of passenger journeys and of 9·1 per cent. in the receipts from passengers. Passenger traffic receipts from all sources fell by 7·5 per cent., and there was a saving of only 0·3 per cent. in the passenger train mileage. The freight traffic results were less unsatisfactory. The tonnage had a decrease of 1·6 per cent., but, mainly owing to the advance in rates from February 1st, the receipts were 4·7 per cent. higher. Freight train mileage rose by 0·3 per cent., but trains moved more slowly and the rate of movement fell from 432 net ton miles per engine hour to 407.

THE idea that the London, Midland and Scottish Company was laying down water troughs in Scotland, so that trains could run non-stop between Euston and Glasgow, Edinburgh and other points in Scotland, is now being abandoned in favour of an anticipated non-stop between Euston and Carnforth. It is pointed out that such a journey would mean a run of 236 miles, as compared with the 326 miles of the Great Western between Paddington and North-road, Plymouth. We remark that were it only desired to exceed the Great Western run, it would suffice to go only to Lancaster—230 miles—and that Lancaster is a more important railway centre, has a modern station, and is the junction for Heysham.

IN our Seven-Day Journal on February 4th it was mentioned that Stroudley's celebrated engine Gladstone was to be preserved. It was built at the Brighton Company's works, and was put into service in December, 1882, and, after forty-four years' service, has been purchased by the Stephenson Locomotive Society, and repainted in the very distinctive yellow adopted by Mr. Stroudley. The intention is to preserve it in the South Kensington Museum, but meanwhile it is to go to the Railway Museum at York. The engine has, during the last two weeks, been open to public inspection, and the money received from the sale of tickets is being given to the Railway Orphanage at Woking. Last Saturday it arrived at Waterloo for public view, and was drawn into the station by the Lord Nelson.

THE Board of Trade export tables for the first three months of the present year show the value of the railway material exported to have been as follows, the corresponding figures for 1926 and 1925 being added in brackets :—Locomotives, £274,309 (£1,193,197, £883,056); rails, £359,187 (£586,327, £483,715); carriages, £619,074 (£556,696, £459,416); wagons, £528,323, (£984,975, £835,310); wheels and axles, £103,651 (£138,933, £172,661); tires and axles, £92,348 (£81,640, £120,523); chairs and metal sleepers, £125,179 (£268,050, £148,759); miscellaneous permanent way, £331,190 (£301,588, £362,112); total permanent way, £1,083,727 (£1,444,375, £1,318,898). The weight of the rails exported was 40,787 tons (74,072 tons, 50,095 tons), and of the chairs and metals sleepers, 13,384 tons (27,107 tons, 11,729 tons). In March, 1927, locomotives to the value of £50,131 were shipped to the Argentine, and £44,053 to other countries in South America, whilst the shipment of rails in March included £44,378 for India, £32,360 to Portuguese East Africa, £21,673 to the Argentine, and £11,422 to South Africa.

A RECENT issue of the *Iron Trade Review* describes and illustrates a method of making railway sleepers out of old flat-bottomed rails. The design involves the use of two pieces of rail for each sleeper. The rails used are those removed from the road-bed as worn and having no value except as scrap. The two lengths are fastened together at each end by metal plates welded in position. The L-shaped fish-plates used in ordinary rail joints can be used for this purpose. When two rails are fastened together in this manner, movement of the sleeper in any way in the ballast is eliminated. For fastening the track rails to the sleeper metal plates are welded to the sleeper and the track rail clamped to these with special devices which cannot slip out of place. A comparative estimate of costs made by the railway shows a total cost of $2·80 for the timber sleeper, while the total cost of making a sleeper of the type described is 60 cents (say, 2s. 6d.), and the scrap value of the rails is $2·50, making an overall cost of $3·10. Inasmuch as the scrap value can be realised out of the rail when it is, later, discarded from service, the net cost of the metal sleeper is reduced to the cost of making, or 60 cents.

Notes and Memoranda.

WHAT is stated to be the world's largest vacuum tube, constructed by the General Electric Company of America, has now, according to *Nature*, been in use in a radio station for several weeks. It is 7½ft. high and weighs 100 lb. It is rated at 100 kilowatts, and is kept cool by a copper jacket through which water is kept circulating. It takes the place of eight 20-kilowatt tubes, which were formerly used. Two ounces of tungsten are used in the filament, which is as thick as the lead in a lead pencil, and is 8ft. long.

ACCORDING to Messrs. M. Park and B. S. Eaton, the use of rubber bearings, with a helical groove to permit water lubrication, has proved a complete success in cases where they are exposed to grit. It appears that a particle of grit, instead of grinding between two metallic surfaces, is rolled across the surface of the rubber bearing, which yields under its impact, until it reaches the groove and the grit is removed by the lubricating water. The coefficient of friction between rubber and shaft, when a constant water film is maintained, is said to be less than that of an oiled babbitted bearing. Rubber bearings have been worked satisfactorily under pressures as high as 350 lb. per square inch, and at speeds as high as 5000 revolutions per minute.

SOME experiments carried out at the University of Illinois on the embrittlement of boiler plates, showed that it was caused by the presence of sodium bicarbonate and a low concentration of the sulphate in the feed water. It was found, however, that increasing the concentration of sodium sulphate or carbonate in relation to that of the hydroxide retarded and eventually prevented the attack. This effect has been studied for several years on an actual boiler, in which the feed-water was maintained with a ratio of sulphate to carbonate of 2 by neutralising about 70 per cent. of the alkalinity with sulphuric acid. After ten years of operation the boiler is in perfect condition, whereas a similar plant working, apart from the water treatment, under identical conditions, was condemned after nine years.

IN commenting on the explosion of a copper pipe, working at a pressure of 175 atmospheres, connected with a small oxygen plant, *Industrial Gases* says :—"Our own view based on the visible condition—a clear indication of high temperature—of the copper pipe at the time the explosion took place, is that some abnormal condition had occurred in the last stage of the compressor—such as sticky delivery valves—thereby superheating the air and lubricating oil during final compression. This air entering the copper pipe at such a temperature, possibly even with ignited oil vapours, would be bound, by heating up the pipe, seriously to lower its factor of safety which, according to all the evidence, was already too low. In the absence of any evidence to the contrary, we believe this explanation of the explosion to be the correct one, and we may add that we have met with similar cases more than once in our experience."

ACCORDING to the *Indian and Eastern Engineer* the Committee, which was appointed to investigate the breakdown of the dredger Sir George Lloyd, used for the Bombay reclamation work, was of the opinion that the governor gear failed to come into action so that the increasing revolutions of the engine were not checked. The finding of the Committee was that, for some unknown cause, the governor emergency gear did not come into operation, nor did the closing of the valve have the desired effect on the engine. As the accident occurred at four in the morning, it is possible that the engineer was not quite so alert as he might have been, and when the engine commenced racing he lost his head. The Committee was satisfied that the load was taken off the engine through the stopping of the suction pipe, though whether it was a complete or only partial choke it was unable to say. It exonerated all the staff from blame.

THE adverse effects of sodium-carbonate solutions on aluminium have, in Dr. Buschlinger's opinion, recorded in the *Chemical Trade Journal*, been largely over-rated, and he points out that attack of the metal by a 5 per cent. soda solution can be entirely prevented by the addition to the solution of 0·05 per cent. of sodium silicate, there being probably formed an insoluble protective layer of aluminium silicate. Sodium bicarbonate does not attack the purest aluminium, whilst potassium nitrate, either solid or in solution, is also without effect upon aluminum. For the distillation or other treatment of ceresine, crude tar, asphalt, montan wax, &c., aluminium has proved of the utmost service, and the German writer points out that the metal has proved of quite exceptional utility in the treatment of transformer oils. It is well known that the viscosity of these oils is influenced adversely when they are brought into contact with heavy metals at even moderate temperatures. This is due either to catalytic action of the heavy metal or to the presence of fine suspended particles. With aluminium, however, no undesirable thickening of the oil is experienced.

THE rectifying action of crystal detectors, states a writer in the *Wireless World*, has been the subject of many theories and much speculation. At one time it was thought that the rectification was due to a thermal effect, and more recently an electronic theory has been put forward which accounts for many of the observed phenomena. The distribution of sensitive and insensitive spots over the surface of a crystal, however, does not seem to obey any fixed law, and no theories have so far been advanced which satisfactorily account for the fact that good and bad spots are often found in close proximity. Some light is thrown on this problem, however, by the results of investigations by Messrs. A. Schleede and H. Buggisch of the chemical composition of galena. They have shown that small crystals of galena, chemically formed from lead and sulphur, are not of uniform chemical composition and that certain crystals contain more sulphur than is indicated by the chemical formula. It was found that crystals with the highest sensitivity as detectors contained an excess of sulphur. The logical conclusion is that minute crystals rich in sulphur constitute the sensitive spots in a galena crystal detector, and in this discovery also is to be found an explanation of the wide difference in quality between specimens of natural galena mined in different parts of the world.

Miscellanea.

AN electrical exhibition is to be held in Melbourne in September.

THE imports of electrical machinery into South Africa increased last year by £825,000 as compared with 1925.

IT is said that a seam of coal has been found during the process of sinking a well at Radford Semele, near Leamington.

THE Calcutta and Bombay stations of the Indian Broadcasting Company will begin to work in August. These stations, which are equal in power to the London station, will cost about 1½ lakhs of rupees each, including sites, buildings and apparatus.

THE new company that has been formed for air transport between Tasmania and the Australian mainland proposes to purchase four amphibians, of British manufacture, at an estimated cost of £12,000 each, and four spare engines at £1500 each. A further £2000 is allocated to machine and engine spares, making a total of £56,000.

"THE Story of the Electric Detonator" is depicted in a new educational cinematograph film recently completed by the U.S. Bureau of Mines, in co-operation with one of the large explosive-manufacturing concerns in America. The film shows in graphic detail the methods of manufacture and use of this modern device for the firing of explosives.

IT is expected that work will be put in hand this year on a new turning basin, 1000ft. square, near the river entrance at East London, South Africa. It is anticipated that two years will be required to complete the work, when it is hoped that lighter work in the roadstead will cease. The Union-Castle Company has given an undertaking that if sufficient water in the harbour and a safe entrance is provided, the mail boats will be brought inside.

THE Finance Committee of the Burma Legislative Council has sanctioned the estimate of 34 lakhs of rupees for the remodelling of the Salin Canal system. The Committee has also approved the grant of financial assistance amounting to Rs. 3 lakhs to the Development Trust for the reclamation of the Singan Swamp at Athlone. A project for remodelling the Pyaungbya Branch Canal has been sanctioned and is expected to cost about Rs. 9 lakhs.

THE hydro-electric schemes undertaken by the Victorian State Electricity Commission are, according to the *Industrial Australian*, proceeding apace. The main channel work in connection with the Rubicon scheme is nearing completion. Pipe tracks have been cleared and excavated down the face of the range, where the fall is 1500ft. The laying of the high-pressure pipes will begin shortly, as contracts have been let for the supply of £40,000 worth of steel piping.

SIX new shafts are being sunk in the coalfields of the Don Basin by the Soviet Union. These will open a new section to be called the New Don Basin. During the coming summer work will be started on nine more shafts. It is estimated that the fifteen shafts will yield, when completed, 6,500,000 tons of coal yearly. The output of coal from mines operated by the Donugol Trust in the Don Basin for February was 1,600,000 metric tons, an increase of 6·6 per cent. over January.

SOME minor adjustments in the wave lengths of European broadcasting stations necessitated by recent experience have been arranged—subject to the approval of the respective Governments—during the present week of conferences of the International Broadcasting Union (Union Internationale de Radiophonie) at Lausanne. The Council of the Union has also sanctioned a proposal of the Technical Commission for the establishment of a permanent control post for nightly observations upon the technical behaviour of European stations.

A SCHEME is under consideration for heating the whole of Reykiavik, the capital of Iceland, by water derived from subterranean hot springs. There are said to be twenty-nine volcanoes on the island, seven of them still active, including the world-famous Geyser, the water issuing from which has a temperature of 127 deg. Cent. at an accessible depth. There are other smaller sources with temperatures above 100 deg. The scheme proposed provides for collecting the hot water and conducting it in a pipe line to the capital, where it will still have a sufficiently high temperature to serve the desired purpose.

THE Hackney Electricity Committee has submitted a report to the Borough Council on extensions to the electricity undertaking to be carried out during the periods 1927–28 and 1929–30. For the period 1927–28 an expenditure of £131,400 is proposed, which would include the substitution of one 10,000-kilowatt turbo-alternator for the 5000-kilowatt set at present in use, and the installation of additional plant and equipment at six sub-stations. During 1929–30 extensions are recommended involving an estimated expenditure of £199,890. This would include further additions to existing and the erection of new sub-stations, and the laying of extra high-tension feeders. The Committee has recommended that application be made to the London and Home Counties Joint Electricity Authority and the Electricity Commissioners for sanction to the scheme and necessary loans.

A JOINT-STOCK company is, according to the *Iron and Coal Trades Review*, to be formed in Central Germany, under the title of Braunkohlengas A.G. (Lignite Gas Company), with a share capital of 2,000,000 marks (£100,000) to study the problem of long-distance distribution of gas produced from lignite. It is of interest to note that the sole patent rights throughout the world for the manufacture of gas from brown coals and lignite, suitable for long-distance transmission, are in British hands. They have been taken out by the Sensible Heat Distillation Company, and will be worked in Germany by the German branch of that company—the Continentale "L & N" Kohlendestillation A.G.—and in Australia by the Commonwealth branch of the parent company. The Australian company will be known as the "L & N" Brown Coal, Ltd. It is proposed by the new system to produce the gas in the centre of some industrial district, as close to the pithead as possible, and to pipe it for light, heat and power purposes over a radius up to 90 miles.

LARGE ELECTRIC CABLE ARMOURING MACHINE

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(*For description see page* 560)

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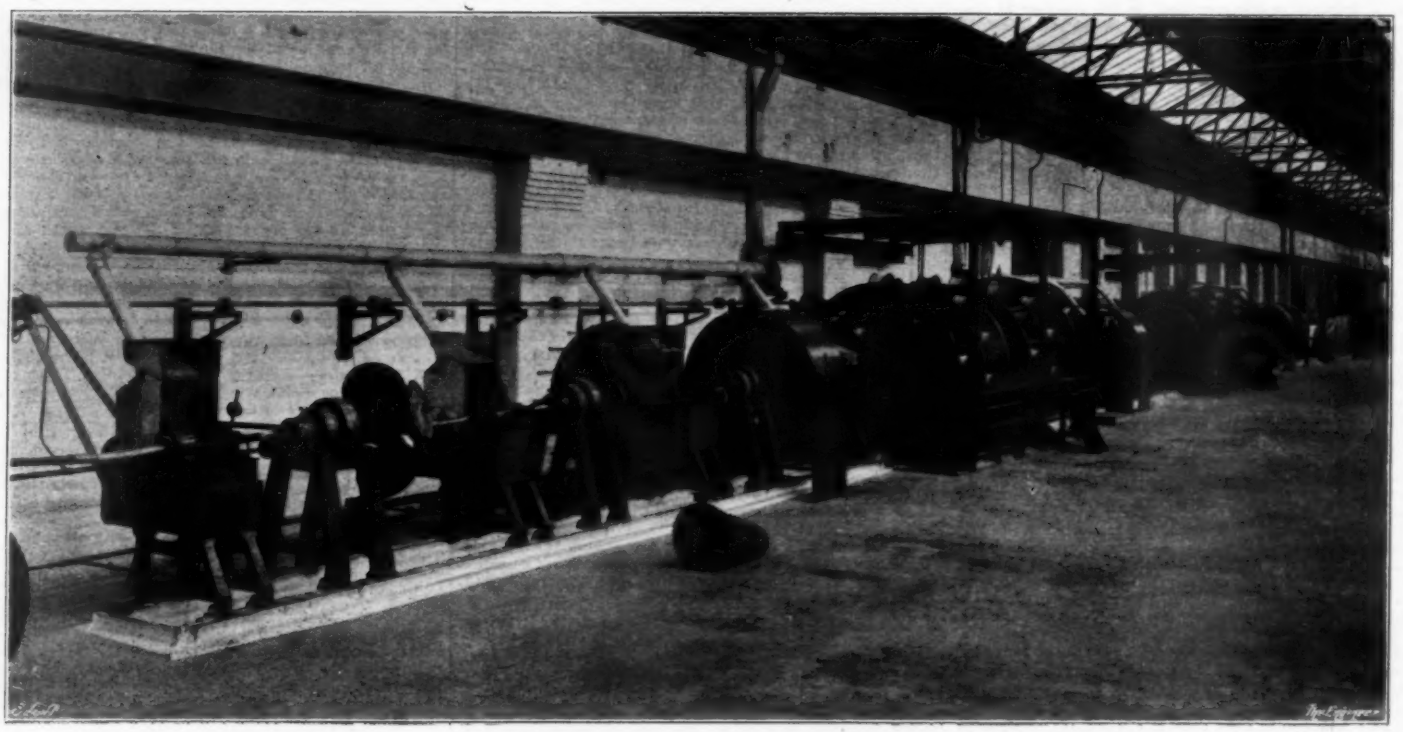
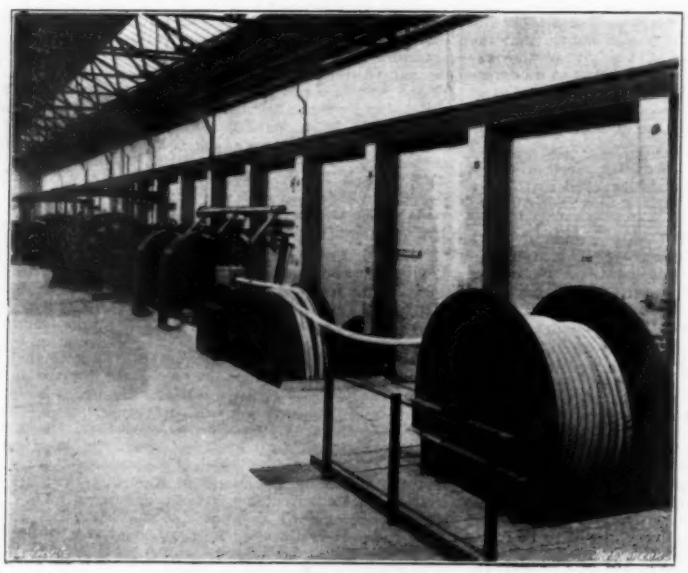
TWO OF THE JUTE DISCS



GENERAL VIEW OF MACHINE FROM FEED END



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THE ENGINEER.

MAY 20, 1927.

The Armament of Capital Ships.

UPON the completion of the Nelson and Rodney this year three full years must elapse before the keel of another capital ship can be laid in this country or elsewhere. The "naval holiday" which the Washington Treaty inaugurated is to be observed until the end of 1930, and there is no reason to anticipate a denunciation of the compact in the interval. Under these circumstances the future development of the capital ship may not appear to be a question of urgent importance. Nevertheless, it is undoubtedly receiving attention by the leading admiralties of the world. From statements in the American Press, the United States naval authorities have already begun to prepare tentative designs for the two battleships which they propose to lay down in 1931, while a recent announcement by the Minister of Marine at Tokyo indicates that Japan considers the replacement of her older capital ships to be essential for her security. We may also be assured that our own Department of Naval Construction will be found ready with its plans when the time comes to build those successors to the "Nelson" class to which Admiral Chatfield referred on the occasion of a recent warship launching. Even on the Continent, where the great ship has been under a cloud for some time past, there are signs of a reviving interest in this type of vessel. Neither in France nor in Italy is naval opinion unanimous in regarding the battleship as an anachronism. Confidence in the powers of the submarine and the aeroplane seems to be waning, possibly as the result of experience at manœuvres, which may have shown the capital ship to be less vulnerable to these weapons and more formidable in itself, than had been supposed. Or it may be that the views of continental naval students have been modified by their researches into the ample store of war data which is now available. Be that as it may, so long as the capital ship remains standardised at 35,000 tons, only the very wealthiest States can afford to build such vessels. But were the limit of displacement as fixed at the Washington Conference to be drastically reduced, it is more than possible that capital units would be incorporated in the building programmes of countries which, since the war, have built only light craft. There is, indeed, some reason to believe that smaller ships will be advocated at the forthcoming conference at Geneva. It is unofficially reported that Great Britain will suggest a limit of 20,000 tons for future vessels, and that Japan will second the proposal. Such a reduction in displacement, provided it were universally accepted, would involve no loss of relative naval strength in any quarter, but, on the other hand, the cost of battleship construction would be sensibly diminished. It remains to be seen whether this proposal will, in fact, be sponsored by the British Government.

In the meantime, the question of fighting power in proportion to total displacement forms the theme of a thoughtful paper in the May issue of the *Marine Rundschau* from the pen of Commander G. Paschen. This officer is exceptionally well qualified to discuss the subject, for it was he who directed the fire of the German battle-cruiser Lützow at Jutland, from which action all the most valuable data relating to heavy artillery tactics in modern naval warfare have been derived. The Lützow, together with the Derfflinger, Seydlitz and other consorts of the German First Scouting Group, maintained on that occasion a fire the rapidity and accuracy of which was attested by its results, and to which the British commanders have paid ungrudging tribute. Commander Paschen's views on naval gunnery are thus entitled to careful consideration. They are, no doubt, highly unorthodox. Briefly, his contention is that the modern capital ship is overloaded with superfluous guns. The "Nelson" class, for example, mounts nine 16in. guns, and no other capital ship of post-war design carries less than eight of these weapons. American battleships under construction before the Washington Conference were to have mounted no less than twelve guns of this calibre, while contemporary Japanese ships were designed for ten. Commander Paschen maintains, however, that all requirements would be met by an armament of four big guns housed in twin turrets, so disposed as to cover the greatest possible arc of fire. His objections to a larger number of guns are severely practical. At the Battle of Jutland, both fleets engaged in salvo firing by the same method, namely, by discharging alternate salvos from the right-hand and left-hand gun in each of the turrets. Thus ships with four turrets fired four projectiles at each salvo, and as a rule the second salvo was not fired until the splash of the first had been observed and reported. Consequently, the interval between salvos was determined by the time of flight, which at the ranges prevailing in this action varied from 25 to 30 seconds. Now even with the mountings in use at the date of Jutland, it proved quite easy to re-load the guns in this space of time, so that, had it been necessary, the guns from which the first salvo was fired would have been ready to deliver the second immediately after receiving the "spotter's" report. In a sense therefore four of the Lützow's eight guns were superfluous when she was engaging a single opponent, since the same rate and volume of fire could have been maintained with only half of her actual armament. The firing of full salvos, that is to say, the simultaneous discharge of all eight guns, was inadmissible for two reasons, first, on account of the tremendous stress to which the structure of the ship would have been subjected, and, secondly, because the splash of so many projectiles would have obscured the target for an appreciable interval, and thus caused a serious delay in correcting the range. On these grounds therefore Commander Paschen strongly urges the restriction of the heavy armament of future battleships to four guns. He is all in favour of large calibres, the ballistic advantages of which are, indeed, almost too obvious to need demonstration. Taking two guns, one of 12in. and the other of 16in. calibre, with a uniform initial velocity of 850 metre-seconds and a muzzle energy of 15,100 and 35,536 metre-tons respectively, it has been found that at the end of a flight of 14,000 m. the velocity of the 12in. projectile has fallen to 520 metre-seconds and the energy to 5651 metre-tons, the corresponding figures for the 16in. shell being 618 metre-seconds and 18,834 metre-tons. The energy of the lighter projectile therefore declines by 62·6 per cent., that of the heavier only by 47 per cent.

While Commander Paschen has presented a strong case for reducing the number of guns, we are not sure that it is wholly convincing. In our judgment, he does not make sufficient allowance for the risk of turret casualties in action, a risk which war experience showed to be extraordinarily great. In the Battle of Jutland disabling hits on gun turrets occurred with alarming frequency. The Lion had one of her four turrets knocked out at an early stage of the action; the Princess Royal suffered in the same way. On the German side, the Derfflinger had two turrets permanently disabled in rapid succession; of the ten big guns in the Seydlitz, four, if not six, were silenced before the end of the battle, and at one period all the eight guns of the Von der Tann were out of action through hits or mechanical defects—a fact revealed for

the first time in the German official history of Jutland. In view of these experiences, it would appear to be a very dubious policy to limit the armament of a ship to four guns in twin turrets, since two direct hits might suffice to put her whole main battery out of commission. True, by reducing the number of turrets it is possible to give the remaining gun positions improved armour protection, as has been done in the "Nelson" class, but there still remains the danger of the turret being disabled by some derangement of the training mechanism through an outside hit. A turret that is absolutely proof against heavy shell fire has yet to be designed, and until the main armament of a battleship can be rendered much less vulnerable than is now the case we do not think the number of guns could be safely reduced to less than eight. On the other hand, Commander Paschen's recommendations will gain in importance if the displacement of future battleships is restricted by international agreement to 20,000 tons. In that event, it will become necessary to reduce either the number or the calibre of the guns, and expert opinion would probably favour the former alternative, in spite of the increased risk of disablement to which we have referred. A demand will then be raised for greater rapidity of fire, a problem with which ordnance engineers are prepared to grapple when the need arises. It is no secret that in certain warships built in this country for foreign Governments during the pre-war period, the main armament was equipped for a higher rate of fire than was deemed necessary in his Majesty's ships. Incidentally, the advantages of super-rapid loading were emphasised by Major L. Fea, of the Italian naval service, in a paper read before the Institution of Naval Architects at the summer meetings in 1922. That officer's conclusions were closely in line with those reached by Commander Paschen. If, said Major Fea, it were practicable to reduce the speed of loading of all guns below the period of the complete rolling of the ship, or, better still, below the half period of rolling, the number of guns could then be reduced to correspond with the minimum number of projectiles necessary for each salvo. The number of heavy guns in each ship could thus be reduced by about one-half, without in any way impairing the offensive power of the vessel. "Therefore," it was added, "there would seem to be a possible way of reducing the displacement of battleships in the near future by building 'super-rapid' gun mountings, which would require only 10 seconds between each shot, and possibly even less. Although to-day this seems rather difficult to attain, it does not seem altogether impossible. . . ." The foregoing considerations, which for the moment are of academic interest, are likely to assume a very practical importance if the dimensions of battleships are to be further circumscribed by diplomatic action.

The Idea of Power for Nothing.

When low-pressure steam is required for heating or process work, and there is simultaneously a demand for power, the economy of using the same steam for power and heat has long been recognised. In the typical case, the steam is generated at a reasonably high pressure, and after being made to do work in the turbine or engine, it is exhausted at a comparatively low pressure into the heating system. When such a duplication of the duty of the steam is provided for, it is not uncommon for the claim to be made that the power is being obtained "practically for nothing." Sometimes, indeed, the word "practically" is omitted, and even when it is used, it is often merely a recognition of the fact that little more heat is required to generate a pound of steam at a high pressure than at a low one. Reference to steam tables will show how small this difference is. Steam can be generated at 200 lb. pressure for an expenditure of heat less than 5 per cent. greater than that required to generate it at atmospheric pressure. It is no doubt this fact which is largely responsible for the idea that the work obtained from the steam before it is passed into the heating system is obtained for the consumption of an insignificant extra quantity of coal. The fallacy of such reasoning, however, should be obvious. A pound of high-pressure steam, after doing work in a turbine and exhausting at atmospheric pressure, is not at all the same thing as a pound of live steam at atmospheric pressure. It is not, in fact, a pound of steam at all, but a pound of a mixture of steam and water. If, in its original state it was dry steam at 200 lb. pressure, adiabatic expansion to atmospheric pressure would turn 14 per cent. of it into water, so that only 0·86 lb. would pass on as steam to the heating system. For an equal amount of heating, therefore, the boiler would have to supply about one-sixth more high-pressure steam to be used for heating at second-hand, than low-pressure steam to be used for heating directly. The power developed by the steam in the first case has therefore not been obtained for nothing. There is no way of juggling with methods or figures which will get over the fact that for every horse-power hour of work produced, 2545 B.Th.U. must go out of existence. These units have to be provided by the fuel, in addition to the quantity of heat which has to be rejected at a low temperature in accordance with the exigencies of the cycle. The events which occur under ordinary circumstances in a combined power and heating plant are easily demonstrated by a little arithmetic. If the steam is generated at 200 lb. absolute pressure from water at 60 deg. Fah., every pound of steam leaving the boiler will carry with it 1177·4 B.Th.U., which have to be provided by the fuel. If this steam is expanded down to atmospheric pressure in a perfect engine, it will give up 191·4 B.Th.U. of this heat, or 0·075 horse-power hour, in the form of mechanical work, and carry away 986·0 B.Th.U. with it when it leaves the cylinder. This exhaust steam will be very wet, and assuming the water of condensation to be drained away, there will only be 0·86 lb. of dry steam at atmospheric pressure for use in the heating pipes. The condensation of this steam will give up 834·8 B.Th.U. as heat. To deliver that amount of heat by means of live steam at atmospheric pressure, the furnace would have to provide 965·5 B.Th.U., so that the 191·4 B.Th.U. of useful work has been obtained for an expenditure of 211·9 B.Th.U. in the form of fuel. By making other assumptions as to the temperature of the feed water and of the drains from the heating system, the figures would, of course, be slightly altered; but, in any event, they are sufficient to show that the mechanical work has been obtained for a very advantageous fuel consumption. The thermal efficiency of the process, as assumed, is indeed over 90 per cent., and an efficiency of 100 per cent. would have been theoretically obtained if all drains were assumed to be returned to the boiler at 212 deg. Fah. But even an efficiency of 100 per cent. would not imply that power was being obtained for nothing.

There is a close analogy between the principle of adding an extra high-pressure steam plant to an existing power station, and that of taking power from steam before it is used for heating purposes. The power from the high-pressure steam is not obtained "for nothing" in one case more than in the other, though in both it is very economically produced. Theoretically, the extra power obtained by "compounding" the station is obtained for an expenditure of exactly its equivalent in heat, whereas nothing like this result is possible as regards the rest of the power. The overall efficiency of the station is thus materially raised by the addition of extra high-pressure plant. How much is theoretically possible in this direction, even without reheating the steam before it enters the low-pressure turbines, is easily shown. We will suppose an existing plant to work with steam at 280 lb. absolute pressure and a temperature of 500 deg. Fah., and to exhaust into a vacuum of 29in.; the machinery will be assumed to be perfect and the Rankine cycle of operations to be followed. In such a plant, for every pound of steam used, the furnace would have to supply 1218·4 B.Th.U., of which 413·57 B.Th.U., or 33·9 per cent., could be turned into useful work. If a high-pressure boiler and turbine were added, working with steam at 850 lb. pressure and a temperature of 780 deg. Fah., the turbine could be designed, theoretically, to produce exhaust steam at exactly the same pressure and superheat as the live steam from the original low-pressure boilers. Hence, by the addition of such a high-pressure plant, the station would be perfectly compounded. To generate a pound of high-pressure steam, the furnaces would have to deliver 1345·2 − 1218·4, or 126·8 B.Th.U. more heat than required to produce a pound of low-pressure steam. The high-pressure steam would, however, have 540·37 − 413·57, or 126·8 B.Th.U. more available energy per pound than the low-pressure steam. Hence the whole of the additional heat supplied by reason of the compounding can theoretically be turned into useful work, whereas only 33·9 per cent. of the heat employed in making the low-pressure steam can be so employed. The overall efficiency of the plant would be raised from 33·9 to 40·1 per cent. by compounding, and the steam theoretically required per kilowatt-hour would be reduced from 8·25 lb. to 6·3 lb. Regarded in another way, for the same amount of heat in the fuel, the power produced is increased by over 18 per cent. It is misleading, however, to regard this result as implying the production of power for nothing. Every kilowatt-hour has to be paid for by the expenditure of 3412 B.Th.U. What really happens is that the efficiency of the whole station is increased by an increase in the "mean effective temperature" of the heat cycle, and the heat units on an average will therefore do more work. The heat per pound of steam which is uselessly, though necessarily, carried away by the circulating water, is not altered by generating the steam at a higher pressure and temperature. The additional heat units put into it by this process are therefore all available for work, and can theoretically be converted into work with an efficiency of 100 per cent.

Although there is no question of getting something for nothing in the thermodynamic sense, by combining a power plant with a heating plant, or by adding high-pressure turbines to an existing low-pressure installation, the saving of fuel consequent upon such combinations may be very important. The economy is most striking in the former case, and it is not too much to say that in any factory in which power and heat are both necessary there are the strongest financial motives for studying the advantages of a combined plant. The gains to be made in power station economy by the addition of an extra high-pressure steam plant are not so great, but they are sufficient to attract the attention of many of the most progressive engineers. On the Continent turbines working at 800 lb. per square inch are being employed to reduce the extra high-pressure steam to the pressure of 300 lb. per square inch which exists in the ordinary mains of the station. The plant is running compounded, and the working results are held to justify completely the change which has been made. In England we shall soon have Mr. Roles' plant at work at Bradford, where a 200 lb. station is being compounded by the addition of a high-pressure section working at 1100 lb. It is not unlikely that many existing stations, working at pressures of the order of 200 lb. per square inch, will be developed along similar lines in the future, provided that their present equipment is good enough to be worth retaining. There is an analogy between the compounding of power stations and the "McNaughting" of the old low-pressure beam engines by the addition of a high-pressure cylinder—a practice which gave a new lease of life to engines which otherwise could no longer justify their existence. What the high-pressure of the future will be, no one can yet say, but the struggle for economy is leading engineers far beyond the pressures of yesterday, and if the use of very high-pressure steam for compounding existing plants does not give "power for nothing," it will, at any rate, give extra power very economically and so raise the general efficiency of the stations by the simplest, if not the only, means open to the engineer.

The French Transatlantic Flights.

The disappearance of Captain Nungesser and his companion, Captain Coli, after leaving the French coast on an attempted flight to New York, following so closely upon the similar tragic fate of Captain de Saint-Roman and his navigator and mechanic in endeavouring to cross the South Atlantic from the African coast to Brazil, brings home forcibly the dangers of undertaking feats under conditions which leave only the barest chance of success. In both cases the attempts were extremely hazardous, depending, as they did, upon speed and upon a total absence of mechanical troubles which might matter little to land aeroplanes but which might readily be fatal to machines that fail to keep the air in trans-oceanic flight. The machine flown by Captain de Saint-Roman was of a type employed on long-distance continental routes, but because of the quantity of fuel that had to be carried the aeroplane was so heavily laden that it could only take off by the sacrifice of the floats and, for that reason, the French authorities prohibited the flight, which fact, however, did not prevent Saint-Roman from starting. In the case of Nungesser the machine was scarcely more suitable for a Transatlantic flight. It was a seaplane in the sense that the body had a certain buoyancy which would enable it to remain on the water in a calm sea, but it was so heavily laden that there was scarcely any margin for buoyancy except after more than one-half of the fuel had been consumed. Both the machine and the engine were of a new design. The weight, without fuel and load, was 4200 lb., and the weight of petrol carried was

6173 lb., the total being 10,945 lb. Only 66 lb. could be allowed for food and safety appliances. A wireless transmitting apparatus had to be sacrificed. The carrying surface of the machine was 662 square feet. The engine, designed by a well-known motor engineer, developed 492 horse-power and drove a geared-down propeller having a diameter of 11ft. 6in. While the courage of men who embark upon these venturesome enterprises must be admired, it has to be admitted that there can be no practical utility in flights in which every possibility of mischance has to be ignored. The airmen disappear without aviation being any the better for their sacrifice.

Report on London Waters.

We have recently received a copy of Sir Alexander Houston's Twenty-first Annual Report to the Metropolitan Water Board. It deals with "The Results of the Chemical and Bacteriological Examination of the London Waters for the Twelve Months ended December 31st, 1926."

As is usual with everything that comes from Sir Alexander's pen, the present report is a most instructive document. In his Twentieth Report, it will be remembered, he included a delightful history of the New River undertaking; this year's volume contains a discussion, on somewhat similar lines, of the wells in Kent that are within the Board's sphere ofoperations. The discussion takes the form of descriptions of the two visits, or "rounds," as they are called, which are ordinarily paid monthly to the various wells in order to collect samples of water for analysis. The same method as was used in the last report is employed also in the present instance. Sir Alexander traces the route or routes followed, and keeps up a running commentary regarding the districts traversed and the historic associations with which they are connected. While still among bricks and mortar, he succeeds in making even the most workaday streets alive with interest; and when the open country is reached, he tells in that inimitable prose of his—which, at times, comes very near being verse—of the beauties of those parts of the county of Kent that are traversed. There would seem to be no happening of note which has taken place in those portions of the Garden of England that escapes mention; no man or woman of note of the past or the present to whom reference is not made. There is, too, a series of photographic pictures to illustrate the text, and many of the views are artistic gems.

We should much like to review at greater length this charming piece of writing; but we must refrain, for, truth to tell, there is hardly a word of engineering import, from end to end of it, and we must turn to the more technical sections of the report.

Section I.—Chlorination of Thames Water.

The first subject dealt with is the chlorination of Thames water. The total volume of water dealt with daily is about 76 million gallons, and whereas in 1925 the results were good, those achieved in 1926 are described as being "still better." Since 1916 some two million people have—with intermissions due to floods during which the water is drawn from reservoirs—been supplied with chlorinated Thames water, with only one solitary complaint as regards taste. The complaint in question occurred about November 3rd last year, when there was a slight wave of taste of short duration in the Golders Green and Hendon areas. On inquiry, the "taste" was traced to the cleaning out, under emergency conditions, of a tank at Kempton Park works, and, as Sir Alexander remarks, the circumstance bore so accidental a relation to the chlorination treatment that it may be disregarded as evidence of a temporary failure to produce tasteless water.

During the year 25,000 million gallons of water were treated with 44·61 and 22·02 tons of bleach and liquid chlorine respectively. The average dose applied, stated in terms of available chlorine, was 0·35 part per million gallons, and the average cost of chemicals per million gallons treated worked out at 1s. 0·2d. The net saving during the year, which was due to reduced pumping, was estimated at £13,596, the saving in coal having been at the rate of 26 tons per day, or nearly 9500 tons per annum. Prior to the adoption of chlorination in 1916 the standard of the Staines stored water was always good; only 41·2 per cent. of the samples contained B. coli in 10 c.c. The corresponding figure for the year 1926 was still better, namely, 28·0 per cent., as the result of chorination of raw river water.

Section II.—Chlorination of New River Water.

As contrasted with the treatment of the Thames water, which is only carried out between floods, the New River water is treated during floods, and treatment is consequently very largely confined to the months before and after the beginning of a new year. The full account of the treatment during the winter season 1926–27 is held over until the 1927 Report comes to be written, but it is briefly described as having been "most successful." Although mostly confined to the winter months, however, there are occasionally periods of flood during the spring and summer when chlorination is resorted to. There was one such period in 1926, namely, from April 27th to May 3rd, when the New River was turbid owing to heavy rainfall. There was a second period—from June 18th to July 24th—when chlorine treatment was employed, but in that case it was not because of turbidity; it was in order to see whether chlorination could be undertaken successfully—bacteriologically and as regards absence of taste—during the warm months of the year, and to observe the effect of adding ammonia as well. It was also hoped that the treatment might tend to keep the algal and other growths in check.

The dose of chlorine employed was 0·33 part per million gallons, except from July 1st to 3rd, when it was 0·5 part. The dose of ammonia used was 0·2 part per million, expressed as nitrogen. Permanganate of potassium in the proportion of 0·2 part per million, was also added from July 3rd to 5th. Before treatment was begun the raw New River water contained B. coli in 1 c.c. of water in 59·2 per cent. of the samples examined. After chlorination at Wood Green the corresponding figure for 10 c.c. of water was 2·4 per cent. In other words, there were fewer "positives" in the treated water, even when *ten* times as much water was used for cultural purposes.

During the periods of treatment which extended to forty-two days, 1670 million gallons of water were treated at a total cost of just under £167, or at an average cost of 2s. per million gallons. The actual quantities of chemicals used were:—Chlorine, 2·47 tons; permanganate, 0·26 tons; and ammonia salts, 5·65 tons.

Section III.—Pre-filtration Waters.

The careful examination of the outlet waters from the East London, Staines, Chelsea, and Lambeth storage reservoirs has been carried on uninterruptedly since 1907. The idea underlying the examination of these pre-filtration waters, as they are termed, is that, if they can be pronounced to be epidemiologically "safe," the perfect working of the filtration process becomes almost of secondary importance, except from the point of view of producing a physically attractive product. Sir Alexander remarks that he rather feels that the pulse of the Metropolitan water supply is the condition of these pre-filtration waters, and that, holding that view, he has not scrupled to modify the work of water examination so as to obtain the kind of information required. He admits, in fact, that this investigation into the pre-filtration waters necessarily meant—presumably by reason of limitation of staff, &c.—some curtailment of the number of samples of the water finally passing into supply to be examined, but he maintains that the gain in other directions far more than compensated for that disadvantage.

In an earlier Report Sir Alexander suggested that Londoners were really drinking lake water, though it was true, he said, that the forty-eight lakes were artificial and were called storage reservoirs, and, further, that they were fed from sources which were not free from considerable criticism. "Nevertheless," he now says, "if the hand of man had played no part in their construction, and if, instead of being separated, they had been united to form one vast sheet of water, covering nearly 2000 acres and holding nearly 13,000 million gallons, the impression of security thus created would have been of a very material kind," and he suggests that such a feeling of safety is not misplaced under existing conditions, as the policy of the Water Board is definitely in favour of the equalisation of storage, so far as it is reasonably practicable.

In considering the pre-filtration results, two things should, he continues, be borne in mind—(*a*) the actual results, and (*b*) the inferences to be drawn from them. Both points are important, but the latter may be of extreme significance. For example, there are certain changes which occur in water consequent upon storage which, in his opinion, clearly indicate "safety." One method of showing how much better stored waters are, is to take some of the positive B. coli percentages in the raw waters and contrast them with the relative volumes of stored water yielding somewhat similar percentages. For example, the raw Thames water contained B. coli in 34·6 per cent. of the samples in 0·1 c.c.—or less. "Now," he concludes, "as the Lambeth-Molesey-stored water contained B. coli in 100 c.c. in only 30·5 per cent. of the samples, it may be said that, on this basis, the Molesey stored water was improved over 1000 times."

Section IV.—Barn Elms Experiments.

The Barn Elms experiments were carried out with one filter bed altered so that the rate of filtration through it might be considerably increased, the water passed through it being stored water which had previously been treated in rapid filters at the rate of 134 gallons per square foot per hour. The chief questions it was sought to answer were, how would the filter bed behave when working under these conditions as regarded the following points:—

(1) Would the filtrate from it compare favourably or unfavourably with the filtered waters generally, as judged physically, chemically and bacteriologically?

(2) Would there be an increase or a decrease in the "number of million gallons filtered per acre cleaned"? and

(3) Would there be any evidence of a gradual but progressive blocking of the interior of the filter, resulting in "the number of million gallons filtered per acre cleaned" becoming less and less as time went on?

With regard to the last question, it is pointed out that an adverse verdict would mean that practically the whole bed would have to be turned over and cleaned periodically, as indeed is the custom at some of the works of the Board.

It is difficult, Sir Alexander remarks, to overestimate the importance of these three factors. The first is largely a health question, but the second and third might spell economic success or failure.

We cannot spare space to follow in detail a description of these experiments, but can only give the answers to the questions as they appear in the report with the following introduction:—"In conclusion, it would seem as the result of sixteen months' experience that the following results can be obtained, assuming comparable conditions,* by the methods employed at Barn Elms":—

(1) A final product practically as good as that resulting from the ordinary slow sand filtration process;

(2) Freedom from algal troubles, the primary filters doing all the heavy work and being cleaned seldom or often, with great ease, according to the current condition of the pre-filtration water; and

(3) A much greater output of water—three to four times—per acre of filtration area, allowing for the space covered by the primary filters, per unit of time, and, so far as the final filtration process is concerned, not decreasing proportionately the time between successive cleanings.

Section V.—Walton Works.

The Walton Works, where rapid filtration followed by slow sand filtration and chlorination are employed, were fully described in our issues of July 30th and August 6th and 13th last. They were formally put to work in July, 1926, and were in full running order by October 5th. Apart from some necessary intermissions, they have been in use ever since. With regard to them the report states that some considerable time must elapse before useful conclusions can be drawn, and then continues:—"The rapid filters have laboured under the disadvantage that the reservoir water has been so good as regards absence of growths that no 'holding skin' has developed to keep back the bacteria, as is shown by the very long 'run' between successive 'cleanings,' and it is possible that the Walton stored water, unlike the Barn Elms stored water, requires the use for 'filming' purposes, habitually or occasionally, of a coagulant. However this may be, the results so far have not been good. Much the same is true as regards the secondary slow sand filters; they seem so far to have failed to form an adequate protective film, behaving, indeed, as if they were mere strainers.

"It takes, however, a new works a long time to settle down, and it is hoped that by next year the tale will be different. The wisdom of installing chlorination plants and operating them at the outset has been very apparent in this case. The consumer has suffered in no way; 89 per cent. of the samples after chlorination have contained no B. coli in 100 c.c., and, indeed, the result would probably have been the full 100 per cent. if, on rare occasions, circumstances had not arisen which interfered temporarily with the absolute perfection of the process."

Conclusion.

The remainder of the Report can be summarised briefly. Section VI. discusses "Resistance to Filtration and Microscopical Appearances of the Pre-filtration Waters." In Section VII. are given some meterological notes regarding the year 1926. Section VIII. is devoted to a consideration of "Non-sporing Aerobic 'Lactose-Negative' Microbes"; while in Section IX. there are a few notes regarding "Iodine, Goitre and Water Supply," and Section X. treats of a number of miscellaneous subjects.

The Report, as have been all its forerunners, is clearly and tersely written, and it is plentifully supplied with tables containing a vast quantity of useful data, which lack of space has prevented us even from summarising.

Gas welding has been most commonly employed for chromium alloys, and it is usually done with a reducing flame, that is, with an excess of acetylene. Such a flame makes welding much easier for these particular alloys, but it has the disadvantage of introducing carbon into the weld, resulting in hardness, lack of ductility and difficulty in machining. The remedy is to be found not so much in a departure from the present method of welding as in an improvement in the composition of the alloy. The addition of about 8 per cent. of nickel to high-chromium alloys has been found beneficial, since it refines the grain and improves the ductility and shock resistance, while at the same time it prevents the development of brittleness after welding.

* This point the Report regards as very important, because the reservoir from whi h the water was drawn is so rich in algal and other growths that that might have had a good effect, as in some way taking the place of a coagulant.

Voltage Regulating Equipment for Transmission Lines.

IN a series of articles which appeared in THE ENGINEER between April 16th and May 28th, 1926, we described various makes of alternating-current pressure regulators, and attention was directed to the fact that, on account of the proposals to link up power stations on an extensive scale, there should, sooner or later, be a fair demand for apparatus of that nature. Various schemes are now being drawn up under the Electricity Supply Act of 1926 for the interconnection of generating stations situated a considerable distance apart, and there is no doubt that before long a good deal will be heard about voltage regulating equipment designed for the purpose of reversible energy transfer from one power station to another.

For a transmission scheme of the Newcastle-upon-Tyne Electric Supply Company the Metropolitan-Vickers Electrical Company has recently built some transformers with which power is transmitted from Dunston to the Potterhouse sub-station, near Durham, and from the North Tees power station to the Skernside sub-station near Aycliffe, about 6 miles north of Darlington, the length of the middle section that remains to be completed being about 14 miles.

Each line is designed to carry 24,000 kilovolt-ampères at a pressure of 66,000 volts, but as the generating voltages of the North Tees and Dunston power stations are 11,000 and 6000 volts respectively, transformers are provided at both ends of the system. The Metropolitan-Vickers' transformers that have been provided for raising the pressure are erected near each power station and consist in each case of four three-phase banks of 4000 kilovolt-ampère units, so that the total amount of power that can be transmitted in either direction is 48,000 kilovolt-ampères. The main 66,000-volt outdoor transformers near the North Tees power station are shown in Fig. 1, where the regulator house is to be seen in the background. The transformers are fitted with oil conservators and temperature indicators and they are of the forced-cooled type. The high-tension leads are brought out through condenser bushing terminals and connected to a set of overhead wires, whilst the low-tension connections are made by means of cables terminating in an oil-filled cable box. As the illustration Fig. 1 shows, the transformers are mounted on concrete plinths to enable them to be moved bodily into a truck which runs on rails laid between the transformer banks.

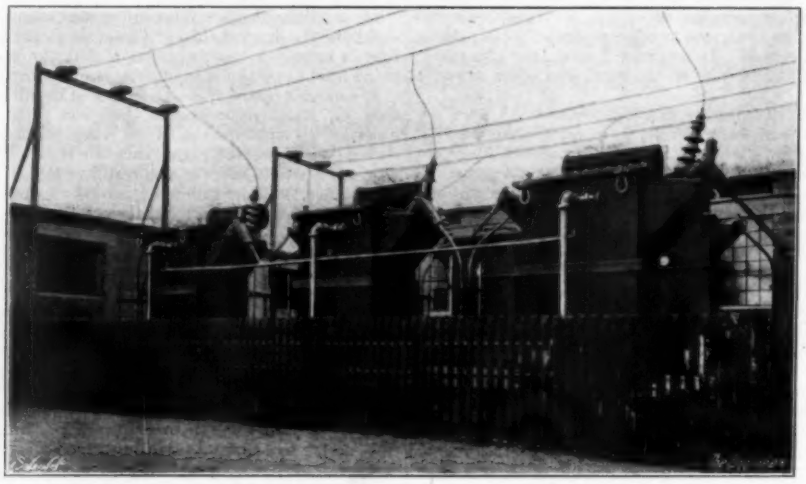


FIG. 1—66,000-VOLT TRANSFORMERS NEAR NORTH TEES POWER STATION

A small building near the transformers contains the pumping plant for cooling, and pipes are laid for connecting the oil tanks with this pumping equipment. For controlling the flow of power, voltage regulating equipment consisting of a booster transformer and a regulating auto-transformer with tapping switches has been installed at both ends of the lines. From the station bus-bars the voltage regulating transformer is energised, and by means of tapping switches it supplies the primary of the booster transformer at variable voltage according to the amount of boost required on the 66,000-volt system. The arrangement of the equipment is shown in Fig. 4, where A A_1 is the main transformer, B the voltage regulating transformer, C tapping switches, D a reactance and switch, E E_1 the boosting transformer, and F links for disconnecting the regulating equipment and for earthing the neutral of the main transformer. This diagram relates to the regulating equipment at North Tees, but the Dunston equipment is similar, except for the fact that it is designed for 6000/66,000-volt transformers. Each of the equipments is capable of dealing with a load of 24,000 kilovolt-ampères and of giving a pressure range of minus 4 per cent. to plus 20 per cent. of the normal voltage, whilst, by moving connecting links between the regulating and booster transformer, other ranges of boost with the same total variation can be secured; that is to say, it is possible to obtain a range of minus 8 to plus 16 per cent. or minus 12 to plus 12 per cent. In each case, however, the voltage variation is obtained in steps of 4 per cent. and the tappings are selected by means of a small master controller which operates the tapping switches through a system of contactors.

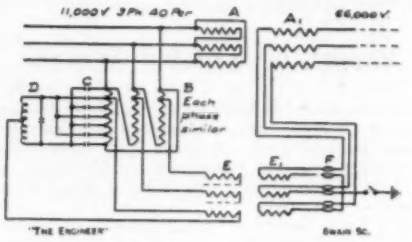


FIG. 4—TRANSFORMER CONNECTIONS

At each end of the transmission lines the booster transformers consist of two three-phase banks of oil-immersed and self-cooled single-phase units, and the voltage regulating auto-transformers are also composed of single-phase units, mounted in the same tanks as the booster transformers. The illustration Fig. 2 shows the tapping switches of one of the equipments in the regulator house, consisting of seven 300-ampère, 11,000-volt, three-pole, oil circuit breakers designed for remote electrical operation.

FIG. 2—METAL-CLAD TAPPING SWITCHES

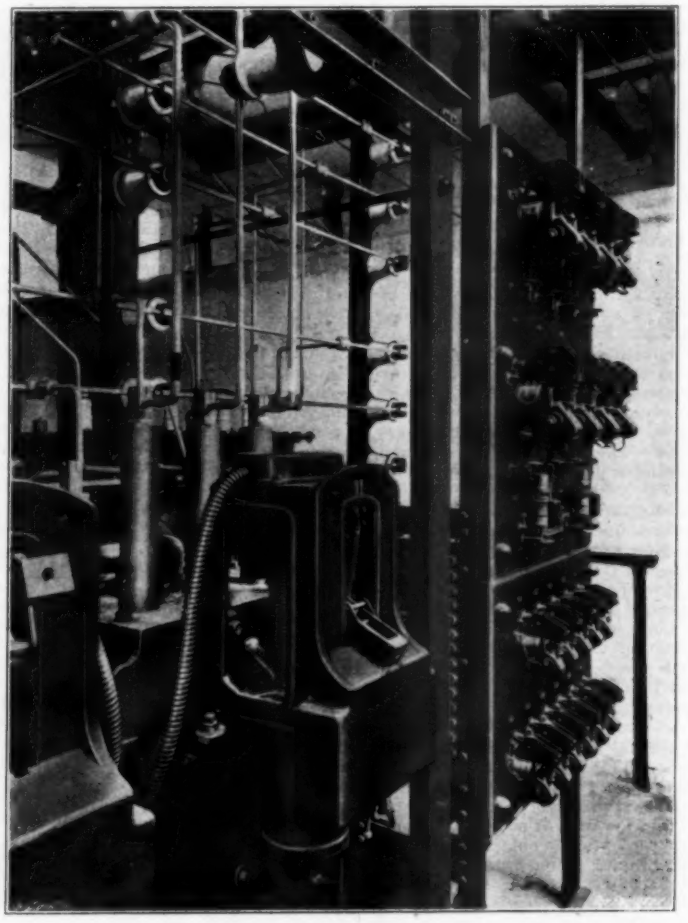


FIG. 3—CONTACTOR PANEL CONTROLLING TAPPING SWITCHES

booster regulators which serve for regulating the voltage at both ends of the lines. Two 66,000-volt lines—the highest voltage lines at present in use in this country—will eventually connect together the company's power stations at Dunston and North Tees, but at present only one of these lines is in operation. The direct distance between these two stations is 30 miles, and the line that is now working takes a route *viâ* the Stoney-Cut sub-station, near the East Coast, whilst the other line has been completed from Dunston to the Potterhouse sub-station, near Durham, and from the North Tees power station to the Skernside sub-station near Aycliffe, about 6 miles north of Darlington, the length of the middle section that remains to be completed being about 14 miles.

Each line is designed to carry 24,000 kilovolt-ampères at a pressure of 66,000 volts, but as the generating voltages of the North Tees and Dunston power stations are 11,000 and 6000 volts respectively, transformers are provided at both ends of the system. The Metropolitan-Vickers' transformers that have been provided for raising the pressure are erected near each power station and consist in each case of four three-phase banks of 4000 kilovolt-ampère units, so that the total amount of power that can be transmitted in either direction is 48,000 kilovolt-ampères. The main 66,000-volt outdoor transformers near the North Tees power station are shown in Fig. 1, where the regulator house is to be seen in the background. The transformers are fitted with oil conservators and temperature indicators and they are of the forced-cooled type. The high-tension leads are brought out through condenser bushing terminals and connected to a set of overhead wires, whilst the low-tension connections are made by means of cables terminating in an oil-filled cable box. As the illustration Fig. 1 shows, the transformers are mounted on concrete plinths to enable them to be moved bodily into a truck which runs on rails laid between the transformer banks.

A small building near the transformers contains the pumping plant for cooling, and pipes are laid for connecting the oil tanks with this pumping equipment. For controlling the flow of power, voltage regulating equipment consisting of a booster transformer and a regulating auto-transformer with tapping switches has been installed at both ends of the lines. From the station bus-bars the voltage regulating transformer is energised, and by means of tapping switches it supplies the primary of the booster transformer at variable voltage according to the amount of boost required on the 66,000-volt system. The arrangement of the equipment is shown in Fig. 4, where A A_1 is the main transformer, B the voltage regulating transformer, C tapping switches, D a reactance and switch, E E_1 the boosting transformer, and F links for disconnecting the regulating equipment and for earthing the neutral of the main transformer. This diagram relates to the regulating equipment at North Tees, but the Dunston equipment is similar, except for the fact that it is designed for 6000/66,000-volt transformers. Each of the equipments is capable of dealing with a load of 24,000 kilovolt-ampères and of giving a pressure range of minus 4 per cent. to plus 20 per cent. of the normal voltage, whilst, by moving connecting links between the regulating and booster transformer, other ranges of boost with the same total variation can be secured; that is to say, it is possible to obtain a range of minus 8 to plus 16 per cent. or minus 12 to plus 12 per cent. In each case, however, the voltage variation is obtained in steps of 4 per cent. and the tappings are selected by means of a small master controller which operates the tapping switches through a system of contactors.

At each end of the transmission lines the booster transformers consist of two three-phase banks of oil-immersed and self-cooled single-phase units, and the voltage regulating auto-transformers are also composed of single-phase units, mounted in the same tanks as the booster transformers. The illustration Fig. 2 shows the tapping switches of one of the equipments in the regulator house, consisting of seven 300-ampère, 11,000-volt, three-pole, oil circuit breakers designed for remote electrical operation. Together with an eight-unit equipment of the same type, for short circuiting the tapping changing reactance, these breakers are mounted on supporting frames. At the end of the row of switches there is the contactor panel shown in Fig. 3, and the contactors on this panel control the closing circuits of the oil circuit breakers. Pilot wires connect the contactors with the master controller, which is mounted in the control room of the generating station some distance from the regulator house. Step-by-step regulation without

interrupting the supply involves the closing of each selected tapping switch before the existing connection on the adjacent tapping switch is opened, and in order that that may be done without short circuiting that part of the transformer winding between the tappings the reactance marked D in Fig. 4 is connected between the two tapping switches, whilst the change is taking place. This connection is made effective by opening a switch that is normally closed across the reactance, and when the reactance switch and a tapping switch are closed, as in normal working, the load current is divided so as to pass through the two parts of the choking coil in opposite directions, with the result that the coil has no inductive effect and therefore it does not produce a reactance drop in the circuit.

Operations following a movement of the master controller are entirely automatic, the first operation being that of opening the reactance switch which makes the reactance operative; next the selected tapping switch closes and immediately afterwards the superseded tapping switch opens, and when the change has been made the reactance switch again closes, an important feature of the arrangement being that the whole sequence of operations is dependent on the correct operation of the reactance switch.

Indicating lamps in the control room show at all times which switches are closed and which are open, and when a tap-changing operation is started an alarm bell rings and continues to ring until the sequence of the operations involved in the change is complete; whilst in the event of the lamps or bell indicating that the change has not been carried out within the prescribed time—a period of about ten seconds—the operator returns the master controller to its former position, when the connections to the previous tapping are re-established. Thus, in spite of any temporary disorganisation of the selector arrangement, the scheme enables the supply to be maintained and investigations can be made in order to ascertain the cause of the failure.

When step-by-step regulation is permissible voltage regulating apparatus of this type forms a reliable and reasonably cheap arrangement, and it is, of course, equally suitable for regulation on feeders and networks of all sizes; but, when smaller currents and lower voltages have to be dealt with, contactors are employed instead of oil circuit breakers. The contactors may be of the ordinary industrial type or preferably of the cam-operated type, and in the latter case, in the event of the supply failing, the apparatus remains set and, if necessary, it can be operated by hand. Under the same conditions ordinary contactors revert to a safe position of no boost, and with either type of equipment the operation may be either semi-automatic or fully automatic. In the former case the initiating impulse is given by means of a manually-operated controller and in the latter case by a controlling relay.

The consulting engineers for the scheme described were Merz and McLellan, of Newcastle-upon-Tyne.

Drawing Steel Wire.*

By E. A. ATKINS, M.I. Mech. E. (Warrington).

A PECULIARITY of wire-drawing is that the pressure which causes reduction is really due to the pull on the wire. It could not be done by pushing, as it would be almost impossible to push a hard material through a conical hole on account of the enormous resisting forces set up. In the case of a pull, however, whilst the pressure on the shoulder may in some cases rise to as much as 150 tons per square inch, there is no difficulty in drawing the wire through the conical hole, due to the fact that the pull simultaneously causes intense neck pressure, bringing about a local collapse of the material, thus assisting it to pass forward. This feature of the "flow" of the steel is illustrated in Fig. 1, and its mechanism probably is very much the same as that which happens in the case either of material or of living beings getting jammed in a tapered opening, in which it will readily be seen that further pressure on the back would but tend to increase the "jam," whereas releasing by a pull from the small side of the opening would reduce the pressure and allow the "flow" to continue. By imagining the wire to be built up of an infinite number of planes at right angles to its axis, and considering what might happen to those planes as they pass through the conical hole, it may be conceived that the pull on the wire will tend to bulge forward the centre of the planes, with the result that the middle portion of the material will always be moving slightly in advance of that which is nearer to the skin of the wire. This central collapsing, therefore, may be the real secret underlying the reducing of wire through a tapered hole.

The amount by which the centre moves forward in advance of the outside, it may be supposed, will vary with the kind of material and the percentage reduction of area. With very light drafting there will be need for the centre portion to move forward perhaps only a molecule or so in advance of the outside; but with heavy drafts the forward movement of the centre will be much greater. When the drafting is heavy enough to cause a pull which is almost equal to the breaking load of the wire, it can be imagined that there will be separation of the steel at its core, the same as in the fracture of an ordinary test-piece which is on the point of breaking in the testing machine. The results of various experiments and tests give support to the theory enunciated.

Dr. Horsburgh has already demonstrated that if a fine hole be drilled at right angles to the axis of a wire and plugged with suitable material and subsequently drawn, the centre of the section moves forward slightly in advance of the two ends. Whilst this method no doubt illustrates the relative movement of the material, it is somewhat open to question on account of the alteration of the cross-section by drilling.

Another method of showing the relative "flow" of core and surface is to square carefully the back end of a piece of wire, and after drawing to note the depth of the concavity at the end of the wire. One such test is illustrated in Fig. 2. This shows a section of a piece of 18-gauge wire, which was reduced from 10 to 18-gauge in six drafts. After each draft the cup was gradually deepened. Several other tests with different sizes of wire and different methods of drafting gave confirmatory results. It was found that when very light drafts were taken the resulting concavity was very small, but when heavier drafts were taken the cavity became deeper. This method, however, is manifestly defective, inasmuch as the material inside the cup is not supported, and, consequently, would draw out considerably more after each draft than if it were solid.

With the object of having the wire solid and at the same time being able to detect the relative "flow" of the material during drawing, several attempts were made to butt-weld different steels, subsequently sectioning them and noting the result. Two pieces of 5-gauge mild steel rod were carefully butt-welded by the electrical resistance method after the ends had been squared, as it was known that the junction would be somewhat decarburised and would give an area of material which would differ in appearance from the main portion of the rod. The rod was then drawn from 5 to 12-gauge wire in five drafts. The welded joint was then carefully sectioned, and when etched it was seen that the centre of the section low in carbon had moved in advance of the outside.

A similar experiment was carried out by butt-welding two rods having such diverse carbon contents as 0·60 per cent. and 0·05 per cent. After air-tempering, the 5-gauge rod was drawn down to 10-gauge wire in five drafts, the high carbon end of the rod passing first through the draw-plate. Careful sectioning of the resulting wire showed that there was apparently no difference between the "flow" of the core and the skin of the wire. It would appear from this experiment that in reducing hard steel by comparatively light drafts there is very little relative movement between the centre and the outside of the wire in passing through the draw-plate. This part of the investigation leads directly to the question of segregated material, which is one of the bugbears of the wire-drawer who desires to manufacture a high-class product.

Segregated Steel.—It is not uncommon to find that

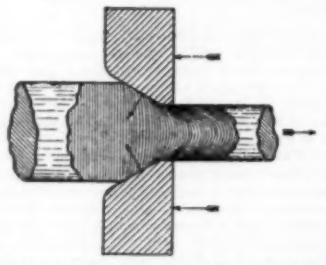


FIG. 1.—Section of Plate and Wire showing "Planes" of Flow.

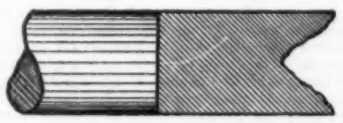


FIG. 2.—Section of Back End of 18 Gauge Wire, showing the concavity induced when drawn from 10 gauge.

FIG. 3.—"Necking-down" caused by Localised Slag Inclusions in Wire

"THE ENGINEER" DRAWN BY.

certain portions of a cast of hard steel have segregations at the core of the rods which, unless the greatest possible care in drawing is exercised, lead either to complete or incipient fractures. Where the core is of a pronouncedly hard type the centre portion of the wire in drawing will break into cups, which may be only about ¼in. apart. Wire of this description is, of course, useless, and dangerous if put into service.

It may be contended that this "cuppiness" can be somewhat obviated by taking very light drafts (or reversing the wire after each draft in drawing), but the steel-maker should remember that it is impossible to examine every piece of rod and subject it to a special treatment to suit its particular peculiarities. Material should be of such a quality that it will give a good quality wire when subjected to the standard practice in wire-drawing.

When steel billets are segregated, the segregation will inevitably be found in the core of the resulting wire, whatever gauge it may be drawn to, and though for some purposes there is no very serious disadvantage in the use of the wire, such material is almost useless for heading or similar work. The stresses set up by the flowing of the steel when cold-headed may be so severe as to cause the material to separate at the neck under very light pressure, or the head itself may split across its centre at right angles to the axis of the bolt. Hard wire drawn from segregated steel, it can readily be understood, is not the best quality to use for ropes.

A mild steel rod when segregated often shows a structure the outside area of which is quite diverse from the inside. In the same manner a high phosphorus material containing ghost lines will cause all sorts of trouble by splitting or breaking when worked up into wire in the cold. As is well known, the banded lines are not easily removed by any ordinary method of heat treatment—and, in any case, it is well to remember that in the treatment of ordinary material abnormal methods of manufacture cannot possibly be adopted to suit varying kinds of steel.

Surface Defects and Hollowness.—Laps or spills on wire may be caused through a bad surface on ingots, due either to splashes in casting of skin blowholes. Defects may be caused during the rolling of the billets into rods by overfilling the grooves, which sets up fins. Fine cracks on billet edges due to a bad composition of steel or to overheating may cause roaks, which result in either broken wire or damaged surface. Insufficient cropping to remove "pipe" will result in producing defective rods or hollow wire, which in most cases is useless.

Effect of Non-Metallic Inclusions.—Slag inclusions in steel, besides causing trouble in drawing the wire to correct sizes, may also result in the necking down of the wire at the parts where the slag inclusions are segregated as groups—Fig. 3. Fortunately, this is not a very common phenomenon, but it may occasionally occur if very dirty steel is used.

The Cause of Wire "Running Out" or not Sizing Correctly—Formerly continual disputes arose between the wire manufacturer and the steel maker as to why some classes of steel, whether acid or basic, could not be drawn correctly to size, the wire sometimes sizing so badly that one rod of a 150 lb. piece might be 17-gauge and the other end 16-gauge or larger. This meant that the wire in passing through the conical hole of the wire-drawer's plate gradually ground or pulled out the hole until it was one or more gauges larger in diameter by the time the complete piece had passed through, the resulting wire, of course, being tapered from end to end. Whilst the wire-drawer blamed the steel, the steel maker attributed the trouble to some defect in the wire-drawer's plate, machinery, or process in connection with the manufacture.

However, many years ago, an examination of the surfaces of evenly drawn and defective wires furnished a clue to the trouble. It was found that the one which drew even-ended had fine, unbroken drawing lines on the surface, whereas the drawing lines on the surface of the wire which "ran out" were broken up, the appearance being somewhat similar to a ploughed field in which the furrows had been trampled down by a herd of cattle. This led to a search for the cause of the breaking up of the drawing lines. Examination of the polished, unetched surfaces of the steels which drew badly indicated the presence of very minute specks of non-metallic material. When drawn into fine wire it was found that the specks were still present in the steel in their original form, thus showing that they were intensely hard and could not be elongated. After careful calculation it was found that this form of fine non-metallic speck was present in the steel sometimes to the extent of 140,000 to the square inch, or about 50 millions to the cubic inch.

Many subsequent examinations of billets, rods, and wire gave fairly accurate information as to the amount that the respective materials would "run out" in wire-drawing. Thus a mild steel, which exhibited about 40,000 specks to the square inch, increased in diameter 10 mils during the last pass when being drawn to 14 gauge, which made the wire 14-gauge at one end and 13-gauge at the other.

The Nature of the Hard Inclusions.—An investigation has been carried out to discover the nature of the inclusions which cause the most trouble in drawing wire to the correct size. The first material dealt with was a hard steel with 0·65 per cent. carbon. The history of its manufacture was unknown, but it ran out of size very badly when drawn into wire. Examination of a 5-gauge rod showed the specks to be of rather large size. Examination at a higher power showed that the inclusions were crystalline in form, being apparently transparent.

A steel was chosen which was definitely "specky" in character, and was completely dissolved, and the residue collected, which, when examined under the microscope, was found to contain some transparent crystals in a conglomerate mass. This was subsequently treated with hydrofluoric acid, which removed the silica but had no apparent action upon the crystals. The residue of crystals was dissolved, and subsequent analysis showed them to be composed of alumina. The great hardness of the crystals was readily shown by lightly pressing a piece of glass upon them and moving it laterally, the result being that the surface of the glass was scratched.

It can be appreciated that such hard crystals of alumina embedded in the steel have a great abrasive power in grinding the hole larger in the wire-drawer's plate. It has, of course, long been known that when aluminium is added to steel it causes trouble in "running out" in wire-drawing, but it is somewhat peculiar to find that the alumina takes the crystalline form.

It was thought that it would be of interest to add definite amounts of aluminium to particular types of steel, to examine these carefully and note the actual results in wire-drawing. First of all, a basic hard steel with 0·65 per cent. carbon and 0·55 per cent. manganese was made, 3·7 oz. of aluminium to the ton being added as the steel was run into the ingot mould. This when examined in the billet form, after polishing only, exhibited specks. When drawn into wire it "ran out" 7 mils whilst being taken down to 17 gauge.

An ingot of the same cast which had no aluminium added to the mould was shown to be practically clean when polished, only one speck appearing on a definite area. This when drawn down to 17-gauge wire was, for all practical purposes, level ended, "running out" less than half a mil in a 160 lb. piece.

A cast of mild steel with 9·3 oz. of aluminium to the ton added to the ingot mould also showed specks, this "running out" no less than 10 mils (more than a gauge) when drawn down from 5-gauge rod to 16-gauge wire.

Another mould of the same cast of mild steel had 19 oz. of aluminium to the ton added, the billets of this when examined showing an enormous number of specks. In attempting to draw this to wire it was found impossible to size at all, as the hole of the draw-plate was almost immediately ground out.

Samples of all the above steels were dissolved and examinations were made for the presence of the hard crystals, and in each of the "specky" materials these were discovered.

The results of the tests and examinations carried out certainly prove that where aluminium is used as a deoxidiser the resulting inclusions have the most pernicious influence in causing wire to "run out" of size through the grinding out of the hole in the draw-plate; but it should be understood that they are only one of the causes of the grinding action. Many cases of the "running out" of wire, in which it can be definitely proved that aluminium was not added to the steel during its manufacture, have

* Iron and Steel Institute. Abstract.

been traced, and careful examinations of these casts show that the minute specks are no doubt manganese-iron silicate, and are, of course, more difficult to get rid of in the process of steel making than the alumina specks.

Besides causing trouble in wire-drawing, the minute hard specks are no doubt one of the causes of the rapid wear of the edges of screwing and other cutting tools when steel of this character is being worked.

It is only fair to say that wire will sometimes "run out" of size for reasons quite apart from the quality of the steel. For instance, if all the scale has not been properly cleaned from the surface of the wire, if it has not been properly coated, or if the lubrication is not sufficiently good, the hole in the draw-plate may pull out. Also, if the hole in the draw-plate is not properly set, or if the material of the latter is not of the right composition or in the correct physical state, the die may not hold up, and consequently as the wire passes through it will increase in diameter.

The Making of Clean Steel Suitable for Wire-Drawing.—As the quality of steel wire and several other products is very seriously affected by small non-metallic inclusions, it is worthy of prolonged investigation to discover the methods by which steels of suitable quality can be produced economically. The problem really resolves itself into one of how best to deoxidise the steel.

The removal of non-metallic inclusions in mild steel is not so difficult as in the case of medium and high-carbon steels, as the mild steel apparently lends itself better to a final prolonged treatment in the furnace with manganese, which gives time for the inclusions to float to the surface. If deoxidation has been carried sufficiently far and there are no further additions of ferro-silicon or aluminium either in the ladle or ingot moulds, there would appear to be nothing, apart from refractory inclusions, which could cause the formation of specks of a non-metallic character.

In the case of high-carbon steels, if the deoxidation in the furnace has not been carried sufficiently far, the additions of ferro-manganese and ferro-silicon in the ladle will result in the formation of silicates, which will not have sufficient time to pass up out of the steel before it is run into the moulds.

Dr. McCance mentions that a possible additional cause of the formation of deleterious inclusions may be the passing back of silicon from the slag into the steel, leaving myriads of silica specks which are ultimately converted into manganese silicate, or a complex silicate of manganese and iron. Possibly this may be the true explanation for the appearance of some kinds of specks.

Dissolved Oxide in Steel.—Perhaps one of the most complex problems in steel making is that of the effect of oxide of iron when in solution in steel. This latter factor is probably one of the disturbing influences in connection with the torsioning of steel wire. The torsion test, which is commonly applied to hard steel wire, consists in twisting to destruction a definite length of the wire, say, equal to 100 diameters. Supposedly good wire will give from thirty to forty or more twists before it fractures, and the fracture usually takes the form of a shear at right angles to the axis, but in wire of indifferent quality it assumes a ragged form.

It is difficult to know what the torsion test actually measures in wire, except perhaps that it is an indication of the density of the steel, its freedom from surface defects, and its general good quality. The torsion test results may, however, be affected in several ways. In the patenting or tempering of wire, if a high temperature is used causing large grain-size, the torsional properties of the wire are usually improved, whilst the other physical properties may be impaired. Again, when wire is drawn from harsh or oxidised steel, the torsional properties are very considerably reduced, and from this it would seem reasonable to conclude that the percentage amount of oxide in solution in the steel is one of the potent factors which affect the twisting of a wire. On the other hand, wire drawn from oxidised steel has considerable torsional stiffness or rigidity, which is a useful property in wire for making the cheaper kind of cylindrical or conical springs which, in practice, twist only a few degrees. It may be that there is some use for a steel or an iron which is definitely alloyed with its own oxide, and the last-mentioned case appears to be an illustration of this.

Surface Blisters after Coating.—A good deal of discussion has taken place recently on the cause of blisters on coated surfaces. These blisters, as has often been proved, actually develop in the pickling cistern, and, in the opinion of the author, are due to minute inclusions which are near the surface, and which, when disintegrated, leave behind products that lift up tin or other metal during or after coating. In galvanising, tinning, or electro-plating, the occluded hydrogen may have a seriously disturbing effect upon the deposited metal.

Unfounded Complaints of Bad Quality Steel.—Whilst the steel maker has all kinds of complaints to deal with in reference to the quality of his steel, there are many cases where complaints are unfounded. In former days material was classified as "good," "bad," or "rotten," and whilst perhaps the latter two qualities were reported to the steel works, the former one was rarely mentioned. But investigation has shown that in some cases high-class material has been spoilt through wrong treatment in passing through the various processes, the quality of steel being blamed if the results were not as anticipated.

A piece of 16-gauge mild steel wire can have very varying physical properties under different conditions of heat treatment. An untreated 16-gauge mild steel wire may have a tensile strength of 64·3 tons per square inch and an elongation of 2·5 per cent., the wire giving forty-six twists in an 8in. length before breaking. After heat treatment the tensile strength may vary between 34 tons and 35 tons per square inch, the elongation between 12·5 and 22·5 per cent., and the twists between 80 and 142. With such varying results of heat treatment it can readily be seen that an almost infinite variety of physical properties can be induced, even in a bit of mild steel wire, under different conditions of annealing. It is thus manifest that where heat treatment is used to bring about certain results there is need of great caution before blaming the steel maker for the bad quality of the steel.

Perhaps one of the most peculiar results obtained in connection with the annealing of mild steel is the extraordinary difference in the grain growth according as the area is reduced in wire drawing. For the purpose of examining this point many wires were drawn out of identical material, and were heated in the annealing furnace in the same position and at the same time so as to insure uniform conditions. Where three wires with respective reductions of area of 10, 20 and 30 per cent. had been annealed at 690 deg. Cent. the number of grains to the square inch were, respectively, 252, 2100 and 3500. At a lower temperature, 590 deg. Cent., the wire, having a 10 per cent. reduction of area, gave 4500 grains to the square inch. Steels giving such varied results have often been denounced as worthless, whereas the problem is purely one of correct heat treatment.

Similarly, in fine wires where the annealing had not been carried out under conditions suitable to a low-carbon material, the grain was caused to grow sufficiently large to cover the full diameter of the wire, causing intense brittleness. Yet only a few inches farther along on the same wire the material was found to be tough and showed small grain.

A much more difficult case to deal with in connection with annealing is where wire has a very low carbon content near the surface and a higher content in the middle portion. This unfortunately often results in large grain growth at the surface, which, if it does not cause fracture, will produce a lumpy appearance on the surface of the wire when bent. There are also cases where the steel of wire or strip has been described as bad, but has simply been made defective by being carburised by contact with carbon monoxide, either through cracked annealing pots or through overheating in the presence of fresh cast iron borings.

Safety in Factories.

A COMMUNICATION has been issued by the Home Office to employers' associations regarding safety-first arrangements in factories and workshops. An abstract of this communication, which bears the date May 16th, 1927, is given below :—

SIR,—I am directed by the Secretary of State to say, for the information of your association, that he has been much concerned to learn from the Chief Inspector of Factories that progress in the development of safety-first arrangements in factories continues to be disappointingly slow. As he has pointed out in Parliament and elsewhere, the need of such arrangements—in industry as elsewhere—is great. The total number of accidents reported to the Factory Department shows no sign of any substantial reduction, and while a certain proportion of these accidents are preventable by fencing and similar mechanical precautions which can be made the subject of specific regulation, experience shows that the majority—perhaps in some cases as much as 60 per cent.—are due to other causes which are not susceptible of being dealt with in this way. It appears therefore to Sir William Joynson-Hicks that the chief, if not the only, hope at present of effecting any substantial reduction in the total number of accidents lies in a much closer and more comprehensive measure of supervision being exercised at the individual factories in regard to all matters affecting safety, and, so far as he can see, such supervision can only be secured through the establishment at the works of special safety organisations which would ensure that the circumstances and causes of all the accidents occurring in the factory are closely investigated and the best methods of carrying on work with safety carefully studied, that the workers are instructed in the risks and imbued with safety-first principles, and generally that all practicable means are taken for the promotion of safety methods in the factory.

How much can be accomplished in this way is proved beyond all doubt by the experience of certain firms which have established safety-first organisations in their works. Particulars of such cases have been given in the Chief Inspector's annual reports from time to time—see in particular pages 20–21 of the report for 1921; pages 13–15 of the report for 1922; pages 24–25 of the report for 1924; and pages 14–15 of the report for 1925. . . . Notwithstanding, however, the excellent results obtained in these and similar cases, the Secretary of State regrets to learn that the example is not being widely followed, and that there is no sign, even in the chief accident-producing industries, of any voluntary movement on the part of the employers generally to grapple with this question. Accordingly, he has felt it his duty to consider whether he should not, in default of voluntary action on the part of the industries themselves, exercise the compulsory powers which are conferred on him by Sec. 29 (3) of the Workmen's Compensation Act, 1923. That section provides that—

> "Where it appears to the Secretary of State that, in view of the number and nature of accidents occurring in any factory or class of factories, special provision ought to be made at that factory or at factories of that class to secure the safety of persons employed therein, he may by order require the occupier to make such reasonable provision by arrangements for special supervision in regard to safety, investigation of the circumstances and causes of accidents, and otherwise as may be specified in the order . . ."

These powers were expressly enacted by Parliament for the purpose of promoting the establishment of special safety organisations in factories, and the Secretary of State feels that in the circumstances above mentioned, he ought not to delay any longer in bringing these powers into operation. He has, accordingly, provisionally approved the issue of an Order on the lines shown in the draft enclosed herewith to provide for the institution of special safety arrangements in the chief accident-producing industries—excepting, for the present, docks, in which he is informed negotiations are already in progress for the establishment of such arrangements on a voluntary basis.

Before proceeding, however, to make the Order, the Secretary of State desires to give the employers' associations in the industries affected by the Order the opportunity to submit their observations on the proposals, with a view in particular to ascertaining whether the employers in any of these industries would not be prepared voluntarily to take the necessary steps to establish arrangements of the kind contemplated in the Order at their works. Sir William Joynson-Hicks recognises that safety organisations of this kind are likely to be most effective when they are established on a voluntary basis, and with the full support of the employers and operatives engaged in the industry, and he would therefore much prefer that employers should establish these arrangements for themselves without being put under any statutory obligation. If he were assured that the employers in any of the industries concerned were ready to adopt effective safety schemes on the lines indicated in the Order—or on such other lines as may be approved—and that effective steps would be taken without delay to institute such arrangements, he would be quite willing, so far as that industry was concerned, to postpone the issue of the Order in order to give the employers the opportunity of dealing with the matter on a voluntary basis. . . .

I am, Sir, Your obedient servant,
JOHN ANDERSON

Draft.

STATUTORY RULES AND ORDERS, 1927, No.....
FACTORY AND WORKSHOP.

The Safety in Factories Order, dated....., 1927, made by the Secretary of State under Sub-section 3 of Sec. 29 of the Workmen's Compensation Act, 1923 (13 & 14 Geo. 5, c. 42) for the purpose of securing the safety of persons employed in certain classes of factories.

In pursuance of Sec. 29 (3) of the Workmen's Compensation Act, 1923, I hereby make the following Order.

1. This Order may be cited as the Safety in Factories Order, 1927, and shall come into force on.....

2. This Order shall apply to the following classes of factories—

(i.) Blast-furnaces for the smelting of iron ore;
(ii.) Iron and steel rolling mills, including tube works;
(iii.) Engineering works in which more than 500 persons are employed, as follows:—
forges; engine building; making of transmission machinery; constructional engineering; hydraulic engineering; electrical engineering (making of dynamos and motors, and cable making); making of agricultural and industrial machinery; making of railway, tramway and motor vehicle plant; ordnance works.
(iv.) Ironfoundries in which more than 50 persons are employed;
(v.) Shipbuilding works.

Provided that nothing in this Order shall apply to any factory the occupier of which is exempted by a certificate of the Chief Inspector of Factories on the ground that other measures not less effective for the prevention of accidents have been adopted in the factory.

3.—(1) The occupier of any factory to which this Order applies may submit for the approval of the Chief Inspector of Factories a scheme for special supervision in regard to safety, investigation of the circumstances and causes of accidents in the factory, and generally the promotion of safety in the factory.

(2) If no such scheme is approved in respect of any factory, the occupier of the factory shall employ a *competent* safety supervisor who shall be responsible directly to the occupier (or, in the case of a company, the managing director), and whose sole duty it shall be :—

(*a*) To maintain a constant supervision over the works, ways, machinery and plant in regard to their safety, to notify to the responsible heads of departments and to the occupier any defects observed, and to report generally to the occupier as to the methods by which the work can be carried on in the safest possible manner;
(*b*) To arrange for and supervise the training of workers newly engaged or transferred to new processes;
(*c*) To investigate every accident occurring in the factory, which is notifiable to the Factory Inspector under the Factory and Workshop Acts, as soon as possible after the occurrence, and to enter the results of his investigation in a book kept for the purpose;
(*d*) In concert with the management and the operatives or their representatives, to organise ways and means of instructing the operatives in the risks attending their work and inculcating "safety-first" principles;
(*e*) To see that all devices or appliances for protection against accident, and, in particular, appliances for stopping machinery when an accident has occurred, are in proper order, and their use and working understood by the operatives concerned;
(*f*) To see that the first-aid and ambulance arrangements are maintained in an efficient state, and that if possible a sufficient number of the operatives in each department of works are trained and exercised in first-aid and ambulance work.

4. A record of every investigation made in pursuance of the preceding paragraph, duly signed and initialled by the safety supervisor, shall be posted up in the works and kept in the form prescribed by the Secretary of State and shall include the following particulars:—(i.) Date and hour of investigation; (ii.) details as to the cause of the accident; (iii.) names and addresses of witnesses (if any); (iv.) precautions recommended to prevent similar accidents; and (v.) the action taken on such recommendations.

The record shall be available for inspection by the Factory Inspector.

5. The occupier shall prepare and forward to the District Inspector at the end of each year a summary of accidents for the factory. Such summary shall be in a form prescribed by the Secretary of State and shall furnish the prescribed particulars showing the rate of accidents according to the number of persons employed and time worked, and the amount of working time lost as the result of such accidents.

THE Société Electrique du Nord-Ouest, in its report for the past year, states that all its power stations are now interconnected, so that a supply can be given throughout the whole of its area, which includes the towns of Amiens, Arras, Dunkirk, Calais, Boulogne, and Abbeville. The company has now about 280 miles of 45,000, 90,000 and 150,000-volt transmission lines in operation. The sales of electricity during the last financial year showed an increase of 21 per cent. over 1925–26.

A New Air Filter for Automobile Engines.

IN our issue of March 24th, 1922, we described and illustrated the Visco air filter as applied to turbo-generator work. It will be recalled that the principle upon which this filter works depends on the efficient filtering action of a large number of short rings cut from very thin coppered steel tubing. The large area presented by a mass of such rings is made even more effective by coating them with a thin film of a blended mineral oil termed "Viscinol." After applying this type of filter to turbo-generator, motor, oil engine and air compressor work, the Visco Engineering Company, Ltd., of 162, Grosvenor-road, London, S.W. 1, has recently designed a new series of air filters which work on this same principle, and are specially suited for use with various types of automobile engines and also small air compressors. One of these new filters is shown in our illustration. It consists, it will be seen, of a mushroom-shaped casing of spun-metal, with a detachable cover which gives access to the filtering cell. The three component parts of the filter are shown in the lower part of the engraving.

Air enters from below and passes upwards through the cell and then downwards through the central tube. The design is such that the filter can be readily attached to the carburetter of a motor car or lorry engine by a tube, or, in the case of air compressors, it may be fitted at a pipe bend. In order to clean the filter cell it is only necessary to lift it out of the casing and to wash it in petrol. The cell may then be re-oiled by dipping it in a shallow tray of Viscinol, or when that oil is not available, a mixture of engine oil and petrol can quite well be employed. After

THE VISCO AIR FILTER FOR AUTOMOBILES

draining off, the cell can be replaced in its casing. In addition to the type of filter shown, other forms are made for use where space is specially restricted, and small filters designed for motor cycle work are also made. For motor lorries and tractors, which may be employed in the dusty climates of Egypt and India, a special design of filter has been prepared, in which the filtering cell rotates in a bath of Viscinol oil, and can be moved occasionally by hand or automatically from the foot throttle or some other part of the engine. In this way the filter used is made practically self-cleansing, and it can be worked over very long periods without attention.

South African Engineering Notes.

Rolling Stock Position.

The following is a summary of the rolling stock position of the Union Railways at December 31st, 1926:—New stock placed in service since Union up to December 31st, 1925: Steam locomotives, 777; coaching vehicles, 1324; goods vehicles, 13,633. Placed in service since January 1st, 1926, to December 31st, 1926: Steam locomotives, 61; coaching vehicles, 238; goods vehicles, 1034. New stock authorised and shipped, under erection, on order, or tenders being invited: Steam locomotives, 81; coaching vehicles, 475; goods vehicles, 1262. Delivery of ten class "U" and ten class "HT" locomotives was expected during March, while two class "GE" locomotives—the balance of an order of ten—had arrived and were under erection at Durban. Of the goods vehicles, 195 are being built or have been authorised to be built in the Administration's workshops. Included in the goods vehicles are 20 steel 76-ton wagons—experimental—which will probably be the largest in use on any 3ft. 6in. gauge lines in the world. The order was given to the Baldwin Locomotive Works and the trucks are being constructed by the Middleton Car and Foundry Company. The load of each is 152,000 lb., the tare is 69,000 lb., and each has six-wheel instead of four-wheel bogies, as on the 50-ton trucks, which are the largest at present in use. Each truck has six bottom discharge doors, three on each side, and they are provided with friction draw-gear in place of the rubber draw-gear at present in service. The adoption of these trucks is one of the results of the visit paid by Mr. G. Titren, Superintendent (Motive Power) to the United States of America, some twelve months ago. An order for a further twenty-five tank wagons for the conveyance of petrol in bulk has been placed with the Baldwin Locomotive Works, delivery to be made in twenty-three weeks from January 1st, 1927. Two three-cylinder engines ordered from Henschel and Sohn, Cassel, Germany, are for use on the Witbank–Germiston line.

Rand Industrial Exhibition.

The Industrial Exhibition recently held at Johannesburg furnished much interesting and valuable information with regard to the very considerable development which has taken place in recent years. One of the outstanding features was the surprisingly high standard of the engineering exhibits. The stand of the Austral Iron Works, where recorders and water meters were shown, attracted a good deal of attention by reason of the intricate craftsmanship displayed in these machines, manufactured entirely in Johannesburg under a South African patent. Gear wheels, too, were shown by this firm, as also by Wright Boag, Ltd., which exhibited a pump of its own manufacture, that attracted a good deal of attention. Near these exhibits was the stand of Rowe, Jewell and Co., Ltd., where were displayed pumps of the firm's manufacture, the largest of which was a four-stage, high lift centrifugal pump, weighing about 3000 lb. Within the main hall were some of the products of the Central Engineering Works, namely, a bore hole pump head, and several light castings and gear wheels, together with a crank shaft and cylinder reconditioned by the latest method of grinding. Another exhibit of note was the First South African Rock Drill, Delfast D 25, the product of Delfos, Ltd., Pretoria, while the Exchange Engineering Works, Ltd., had a surprisingly wide range of goods, comprising fire appliances, plumbers' requisites, windmills, and pumps. The Union Steel Corporation of South Africa had an exhibit which was all the more inspected by reason of the proposed State-aided iron and steel industry, which will be a menace to the company. All the raw materials from which Newcastle pig iron is manufactured were shown, together with the pig itself, while the excellence of the company's steel was well illustrated in a length of 6in. shafting 8ft. long, bright turned, and produced from South African ores. South African bolts and nuts, made from Vereeniging steel—Union Steel Corporation works—were displayed by the South African Bolt and Nut Works, and the Steel Ceilings and Aluminium Works showed cast iron fittings, nails and various castings. Messrs. Haggie, Son and Love, Ltd., displayed wire ropes of all sizes, made at the Jupiter Rope Works.

S. A. Market for Tools.

Not the least interesting feature of the South African market is the steadily widening scope of the trade in all classes of mechanics' tools. Only five years ago the Union's annual imports under this heading were valued at little more than £125,000, whereas, although the complete figures are not yet available, it is obvious that 1926 saw that total more than doubled. In 1925 the annual figure had already reached the £200,000 mark, and British and American firms, supplying approximately 40 and 30 per cent. respectively, had made considerable progress, chiefly at the expense of their continental competitors. Germany has, it is true, also strengthened its position in the market of late, but how far that can be regarded as a permanent achievement or how far it has been the result of abnormal industrial conditions in the United Kingdom, remains to be seen. The maintenance departments of the many factories, which are being opened up in all parts of the Union, the innumerable motor garages and service depôts which are springing into existence to cope with the ever increasing road traffic, and the farmers and planters who are turning more and more to elaborate modern implements and mechanical traction, all represent potential purchasers of mechanics' tools. The remarkable and sustained activity of the building trade is another factor which has influenced the demand to a high degree. The steady development of the Government's railway workshops provides a permanent account of substantial dimensions, as may be judged from the fact that a stock valued at £33,735 was carried last year; while the requirements of hand tools by the Transvaal gold mines are over £106,000 per annum.

Preference on British Goods.

The Electricity Committee of the Durban Town Council is of opinion that a preference of not more than 10 per cent. should be given to goods of British manufacture over those of foreign origin, and has accordingly recommended the acceptance of a tender for auto-transformers from Holland, in connection with which the saving was 14 per cent.; and of a tender for lamps from Austria with which the saving varied from 14 per cent. to 19 per cent. In the case of cables for interconnection between Alice-street and Congella Power Stations, however, it preferred the lowest British offer, the gross difference in price compared with cable from Holland being 9·8 per cent., which would have been appreciably reduced by the consulting engineer's charges for inspection and testing.

Rands Latest Reduction Plant.

An interesting feature of the South African Mining and Engineering *Journal* for March 19th is the reproduction of a diagram of the flow sheet at the enlarged reduction plant now in process of assembly at the West Rand Consolidated Mines, which is controlled by the General Mining and Finance Corporation. The portions of the existing plant to be used in the 80,000-ton reduction plant are:—100 stamps (80 1650 lb. and 20 1900 lb.), 5 5ft. by 16ft. 5in. tube mills; one 6ft. by 16ft. 5in. tube mill; 6 42ft. by 8ft. sands collector tanks, to be used as collectors. The new plant to be added will be:—Washing, sorting and crushing plant, 8 6ft. 6in. by 20ft. tube mills, with Dorr classifiers and Dorr bowl (16ft. bowl); 8 Johnson concentrators; 6 Brown agitator tanks (22ft. by 53ft.); 5 Oliver filters (14ft. by 16ft.); Crowe-Merrill precipitation plant; all complete with pumping plant and other accessories. Two noteworthy features in the plant are the use of continuous filters and of Johnson concentrators. There can be no doubt that the continuous filter has taken its place in Rand slimes treatment practice as a standard feature. Experience hitherto has established its advantages beyond question. The Johnson concentrator is a development made on the East Rand Proprietary Mines, with the co-operation of the Rand Mines' Metallurgical Department. Its aim is to effect a continuous and close separation of pyritic concentrates from the pulp stream, and, judging from all accounts of its performance, it does it most efficiently. In fact, it is believed that the Rand has produced a patented device which will be gratefully adopted by operators the world over. So far, those who have developed it have avoided rather than sought publicity, but now that it is being adopted more extensively, it is to be hoped that an exact account will be furnished. It is understood that an inclined rubber-lined cylinder, with a spiral groove of special contour, is slowly rotated in the pulp stream, and that the concentrates remaining at the bottom of the groove are washed off, at the top of their travel, dropping into a central launder.

Letters to the Editor.

(We do not hold ourselves responsible for the opinions of our correspondents.)

THE BRITISH COLUMBIA ELECTRIC RAILWAY.

SIR,—A clipping has come to hand taken from your issue of February 18th, 1927, reading as follows:—

"The British Columbia Electric Railway, which has under construction a plant on the Bride River that will ultimately develop 60,000 horse-power, at a cost of 30,000,000 dollars, is reported to have decided to begin another plant of similar capacity, which will cost about 38,000,000 dollars. It is expected that the demand for electric power on the lower mainland of British Columbia will increase to such an extent within the next five years that construction on the new project will be necessary."

The figures in the above item are erroneous. The initial development at Bridge River—not Bride River—will be 60,000 horse-power, which is estimated to cost 13,271,000 dollars. The second development will bring the capacity up to 90,000 horse-power at the total cost of 14,700,000 dollars. While the ultimate development is estimated to be about 700,000 horse-power, the cost of it has not yet been figured out.

The figures you published indicate an extravagantly high cost of development.

J. LIGHTBODY,
Publicity Manager, British Columbia Electric Railway Company, Ltd.

Vancouver, B.C., April 20th.

[We are pleased to publish this correction, but would point out that the paragraph which was printed in our issue of February 18th was copied verbatim from a Consular Report.—ED. THE E.]

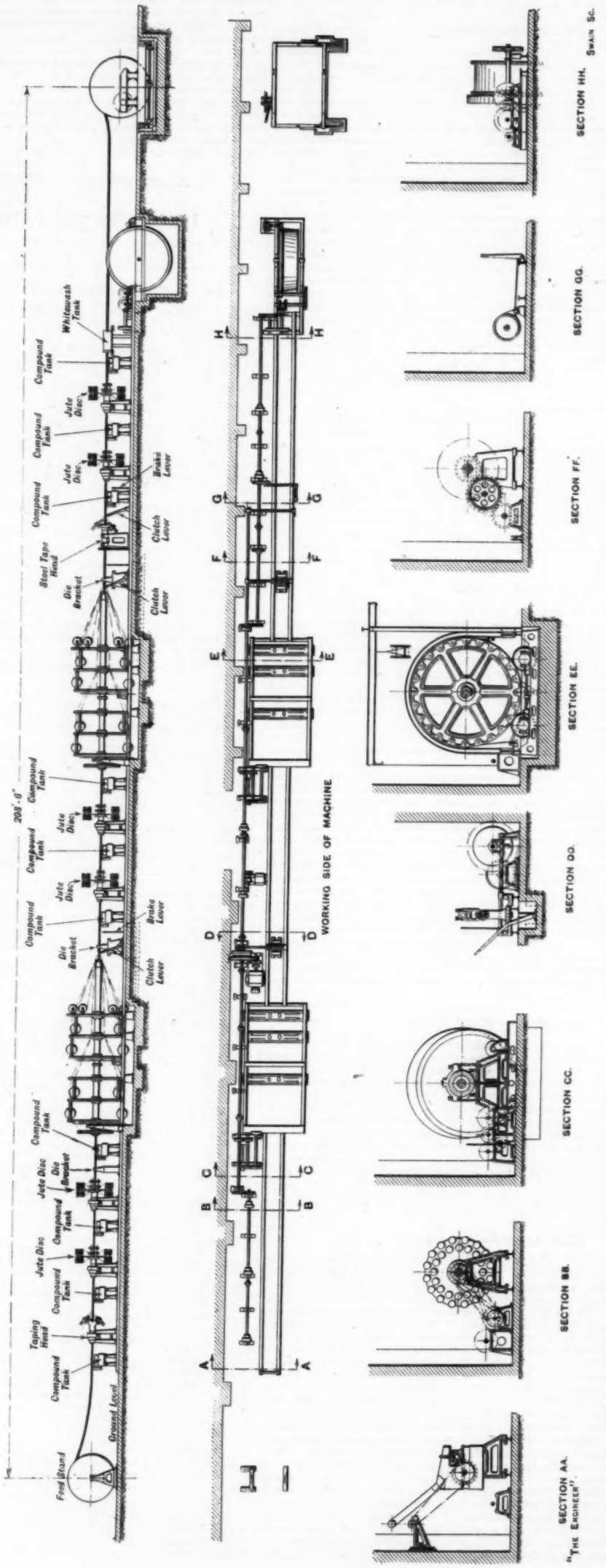
THE ROMANCE OF A CENTURY.—The "Romance of a Century" is the name given to a book which has just been issued by Bemrose and Sons, Ltd., printers, of Derby, to mark the completion of one hundred years' existence of the firm. It bears on the back of its title page the following quaint introduction:—"Here begins the *Romance of a Century*. Printed and bound by craftsmen of the Bemrose tradition, at their establishment in the ancient Borough of Derby. Hand-set in the types of Claude Garamond by Charles Richardson, compositor, from the lay-out of Bernard Cowdy, and printed under the direction of Chas. E. Evans; adorned with plates in colour reproduced by the Derby Print process, to the artist's complete satisfaction, by William Smedley, from water-colour drawings by Herbert J. Finn. An harmonious company withal, finding great pleasure in so congenial a task." The "story" is told, and told well, by Mr. A. E. Owen-Jones, and the publication is in every way delightful. As a piece of print, it is exceedingly good. It is well designed, well laid out, and well printed. The water-colour drawings, which are internal views of the Derby works, are cleverly reproduced, and the paper is first-class. In fact, the book is worthy of the firm that has produced it; a firm, be it said, which has always had a well deserved reputation for producing good work and for treating its workpeople well.

THE INSTITUTION OF STRUCTURAL ENGINEERS.—On Monday evening, May 16th, the annual dinner of the Institution of Structural Engineers was held in the French Restaurant of the Piccadilly Hotel, under the chairmanship of Mr. H. J. Deane, the president of the Institution. About four hundred and twenty members and their guests, including ladies, attended. The chief speaker of the evening was the Right Hon. Lord Carson, who replied to the toast of "Our Country and Empire," which was proposed by Major A. H. S. Waters, V.C., who is a member of the Committee of the Midland Branch of the Institution. Sir Ernest Moir, Bart., proposed the toast of "The Guests," which was responded to by Mr. Frederick Palmer, president of the Institution of Civil Engineers, and the Rev. F. H. Gillingham. The toast of "The Institution of Structural Engineers and its President" was proposed by Sir Henry Fowler, president of the Institution of Mechanical Engineers. In replying to Sir Henry, Mr. Deane made reference to the rapid growth of the Institution of Structural Engineers and to the fact that over one thousand new members were added last year. During the dinner, which was excellent, there was a programme of instrumental music. After the speeches the chair was vacated by the president and a cabaret entertainment followed, after which dancing was continued until two in the morning. The evening was a most successful one and was much enjoyed.

THE INSTITUTION OF CIVIL ENGINEERS.—At the annual general meeting of the Institution of Civil Engineers held on Tuesday evening, May 10th, the result of the ballot for the election of officers was declared as follows:—President, Mr. Ernest Frederic Crosbie Trench (London); Vice-presidents, Sir Archibald Denny, Bart. (London), Sir Brodie Haldane Henderson, K.C.M.G. (London), Sir John Francis Cleverton Snell, G.B.E. (London), Mr. George William Humphreys (London). Other members of Council:—Mr. Robert Donald Thain Alexander, D.S.O. (India), Mr. Henry Newmarch Allott (Manchester), Mr. Thomas Henry Bailey (Wokingham), Mr. William James Eames Binnie (London), Sir Dugald Clerk, K.B.E., F.R.S. (London), Colonel Rookes Evelyn Bell Crompton, Col. R.E. (T.) (London), Professor William Ernest Dalby, F.R.S. (London), Mr. Sydney Bryan Donkin (London), Sir Alexander Gibb, G.B.E. (London), Mr. William Wylie Grierson (Ticehurst), Sir Robert Abbott Hadfield, Bart., F.R.S. (London), Mr. Ernest Prescot Hill (London), Sir Clement Daniel Maggs Hindley (India), Mr. Thomas William Keele (Australia), Sir Cyril Reginald Sutton Kirkpatrick (London), Mr. David Ernest Lloyd-Davies (South Africa), Sir Murdoch MacDonald, K.C.M.G. (London), Sir Henry Percy Maybury, K.C.M.G. (London), Sir Richard Augustine Studdert Redmayne, K.C.B. (London), Mr. Henry Ashman Reed (Manchester), Sir Hugh Reid, Bart. (Glasgow), Professor Robert Julian Scott (New Zealand), Mr. William Archer Porter Tait (Edinburgh), Mr. Henry Hague Vaughan (Canada), Mr. John Duncan Watson (Birmingham), Sir Alfred Fernandez Yarrow, Bart., F.R.S. (London). This Council will take office on the first Tuesday in November, 1927.

MACHINE FOR ARMOURING LARGE-DIAMETER ELECTRIC CABLES

JOHNSON AND PHILLIPS, LTD., CHARLTON, LONDON, ENGINEERS



A Large Cable Armouring Machine.

ONE of the largest, if not actually the largest, of machines ever built for the armouring of electric cables has recently been set to work in the shops of Johnson and Phillips, Ltd., at Charlton, and we noticed, when we inspected it at work, that preparations were being pushed forward for its duplication.

This machine, of which we give a drawing herewith and some half-tone engravings on page 552, is being employed in armouring the 78 miles of extra high-tension cables that the company is making for the Southern Railway, but it is capable of accommodating much heavier work, while it is noteworthy on account of its adaptability.

In view of the fact that in our issue of October 10th, 1924, we gave comprehensive descriptions of several machines of a somewhat similar nature, made by Johnson and Phillips, it is unnecessary here to enlarge on the principles of laying up wires to form cables, and we will go on immediately to outline the special features of the machine under review. Some idea of its magnitude may be gathered from the fact that it is some 220ft. long overall, while it can accommodate cables up to 5¼in. in diameter.

On reference to the drawing it will be seen that the machine comprises over a score of separate units, arranged in line, each of which performs some operation in applying the protective covering to a cable already finished in so far as its electrical properties and its lead sheathing are concerned.

The cable to be armoured is brought into the shop on a drum by an overhead crane and is mounted in a pair of A frames at the left-hand end of the machine. The first unit through which it passes is a tank of melted compound or bitumen, which is kept constantly agitated by a drum driven off a line shaft on the wall behind. The drum also serves to lift a film of compound out of the tank and flow it over the cable as it passes. A die wipes off any surplus compound, and we noticed that, unlike some cable shops, the floor at Charlton was remarkably free from drippings or splashes of compound. Over the tank there is a hood connected with an exhaust fan to draw away any fumes coming from the hot compound.

The next unit in sequence is a rotary head for applying tape, if required. It carries three spools of tape and is driven by belt from the main driving shaft on the floor behind the machine. Two steps on the pulleys provide speeds of 75 and 150 revolutions per minute. The main driving shaft just referred to, it will be seen, runs the whole length of the machine, but is divided into three sections geared together. It forms the connecting link to synchronise the operation of all the units and is of ample proportions to prevent there being any appreciable torque displacement from end to end. Near the centre of its length there is the driving motor, of 50 horse-power, which is connected up through a friction clutch. It will be readily understood that the inertia to be overcome in starting up such a big machine is very considerable, but we noticed that it could be overcome very comfortably and smoothly by the clutch, which could even be allowed to slip for considerable periods, to drive the machine slowly, without distress. The clutch can be operated from several positions along the length of the machine.

Following the taping head referred to above there comes another compound tank and then a "jute disc"—that is to say, an apparatus for wrapping strands of jute round the cable. It comprises a sheet steel disc about 5ft. in diameter, mounted on an overhung belt-driven shaft and running at either 75 or 150 revolutions per minute. On either side of the disc there protrude a number of pins on which are mounted the spools of jute. There is accommodation for sixty-four spools, or thirty-two on each side of the disc. The strands are all gathered together towards the centre and are led through a polished ring on to the cable. The jute, naturally, has little tensile strength and there is a liability for it to break, so the disc is covered by a sheet metal guard and an attendant stands alongside to watch for broken ends. It is astonishing, to the uninitiated, how quickly he notices a breakage—considering the speed at which the machine runs—stops, mends the break, and gets under way again. Beyond the jute disc there is another compound tank, a second jute disc, and again a compound tank.

The following unit is the first section of the real armouring apparatus and comprises a cage for wrapping the cable with galvanised steel wire. The cage is of orthodox pattern, having accommodation for forty-eight bobbins in floating cradles, but will also hold as many as thirty other bobbins round the front end ring. These bobbins, of course, put a twist in the wire as it is applied and, consequently, are only used for comparatively light wire. The cradles for the floating bobbins are mounted on ball bearings and each of them will take about 3½ cwt. of wire. The cage is driven from the main shafting by spur reduction gearing, which is so arranged, with a sliding pinion, that the direction of rotation can be reversed. A brake band round one of the rings is provided for stopping the cage quickly in case of emergency and also for holding it steady while it is being loaded. There is a light overhead gantry, equipped with blocks and tackle for lifting the bobbins into place. When the bobbins are dropped into the cradles, bosses on their ends engage with recesses in the cradle sides and hold them in position while the running spindle is pushed home. It is consequently unnecessary for the men to take the whole weight of the bobbin while the position of the spindle hole is being felt for. Beyond the cage there are the usual lay plate and closing die.

After this wire cage the machine is duplicated lengthways, with the exception that directly after the second closing die there is a head for applying steel tape if that form of armouring is required, while at the extreme end there is a tank for applying whitewash to prevent the cable sticking. Finally there is the draw-off or fleeting wheel, which is 9ft. in diameter and can be driven at a wide range of speeds by means of interchangeable gears. The cable then goes to the take-up stand, where it is coiled on drums for dispatch. The drum is mounted on an adjustable stand and is driven from the fleeting wheel by a chain and slipping clutch. The drums may be as much as 12ft. in diameter and weigh 20 tons.

It should be pointed out that it does not follow that all

the units of this great machine need be used simultaneously as any can be thrown out of gear according to the specification of the cable being armoured. Thus, for instance, if only one layer of armouring is required, it could all be put on with one of the cages and the other left standing, so that it could be re-loaded with fresh wire bobbins—a process which would greatly economise time, as it generally takes considerably longer to re-load the machine than it does to do the actual work of armouring. On the other hand, the two cages can be connected together by means of a tube with, of course, the intervening units removed, and then as many as 120 wires can be put on in one layer. It is noteworthy that the whole of the machine was manufactured in Johnson and Phillips' engineering shops.

Provincial Letters.

THE MIDLANDS AND STAFFORDSHIRE.

(From our own Correspondent.)

Trade Situation.

TRADE conditions in the Midlands and Staffordshire show but little change from recent weeks. The break in coke prices and consequent depreciation in values of raw materials, however, is considered a healthy sign, and freer buying is anticipated in the near future. Steel makers, though still busily engaged, do not find renewed business coming up to expectations. Structural engineers are for the most part fully employed and express confidence in the future. Demand for pig iron shows a slight improvement, and the whole of the production is being disposed of. South Staffordshire forgemen and re-rollers are in most cases poorly off for business. Resources are very irregularly employed, and the amount of business which is going to the Continent on account of price disparity is stated to be increasing. The strip mills are badly hit in this respect. Local nut and bolt works find business brighter, but few orders for Staffordshire bars for this industry are being recevied. The general position in the Coventry motor engineering industry, though leaving room for improvement, shows progress.

Cannock Chase Railway Scheme.

The decision of the Ministry of Transport not to grant an order for the construction of the Cannock Chase light railway has caused surprise and dismay among not only the promoters, but Midland industrialists generally, for the new line was considered a necessity for the full development of the Cannock Chase coalfields. It is difficult to understand the motives which have urged the Minister of Transport to refuse his consent to the construction of the new line, which had the backing of industrialists, miners and local authorities. For nearly thirty years efforts have been made to secure an outlet for Cannock coal to the West and South, and it would appear the latest attempt has shared the fate of the others and ended in failure. Failing the performance of the promises of the London, Midland and Scottish Railway Company, the coalowners themselves projected a line to connect the mining area with the Great Western system near Wolverhampton, and to give access to the main lines by way of Brettell-lane and Stourbridge Junction. At present there is such congestion of coal wagons in the bottle-neck of Walsall and Bescot, which is the only exit for the products of the pits, that the coal is held up for days, and the delay in releasing wagons means that the full output of the mines cannot be got away. That, at a time when industrial development, and especially the development and better organisation of the coal industry, is badly needed, such a negative result should follow from the efforts of those with knowledge of the needs of the district to improve its prospects, is deplorable. There is a strong feeling in the district that the matter cannot be allowed to rest where it is, and it has been suggested that a joint meeting of local authorities of the district should be called to consider the serious position that has arisen as far as the development of the area is concerned.

Black Country Pits' Peril.

A renewal of the flooding menace to many of the Black Country mines has arisen through somewhat unusual and unlooked-for circumstances. It will be recalled that recently it was decided to close down the Buffery engine, and to rely upon the remaining two at Windmill End and Waterfall-lane, Old Hill, to keep the water to a level which would permit the mines to be worked. There has now been a breakdown to the Windmill End pump, and some of the colliery workings in the northern portion of the area are gradually becoming waterlogged. What renders the existing position one of considerable anxiety is the fact that it is impossible at present to effect the necessary repairs to the Windmill End pump, owing to the vast volume of steam caused by the accumulation of water coming in contact with subterranean fires in the vicinity. Fortunately, there is no immediate risk of the flooding of the mines in the southern portion of the Old Hill district; but if the Windmill End pump should be out of action for a prolonged period, there will be the danger that the constantly increasing floods may gravitate there in such volume as to involve the possibility of the overpowering of the Waterfall-lane engine, in which event the district would be faced with the prospect of a disaster similar to that which befell the Tipton mining area. This is the fourth occasion within the last ten months that a critical position has developed in regard to the future of the mines in the Old Hill area.

Birmingham Firm Secures £86,000 Contract.

Considerable satisfaction is expressed that the Midland Railway Carriage and Wagon Company, of Birmingham, should have been successful in securing an order for thirteen passenger coaches for the South African Railways. The contract price is £86,000. It gives additional satisfaction when one learns that there were no less than twenty-five tenders from various British, American and continental firms.

Raw Iron.

The demand for foundry grades of pig iron shows some improvement, and inquiries in circulation lead to the belief that a better latent demand exists than has been the case for many months. As soon as values have crystallised, this demand is expected to make itself evident. It is made plain, however, that the fructification of inquiries depends upon prices. Now that coke prices are easier, the call for cheaper pig iron is intensified. Smelters protest that any economies they can effect in fuel have been discounted. Demand for pig iron has been so sluggish that though the furnaces which have been re-kindled remain in commission, some of them are making only a small output, and smelters eager to secure new orders, especially forward business, in many cases have given way to the extent of about half-a-crown per ton. On 'Change in Birmingham to-day Northamptonshire No. 3 foundry was pretty generally offered at £3 15s., a reduction of half-a-crown on the previous minimum. Buyers, however, claimed to be able to secure supplies at below this figure, and stated that in some cases negotiations had proceeded on the basis of £3 12s. 6d. Derbyshire smelters were stiffer in their attitude, but it was possible to place orders for foundry at £3 17s. 6d., though this appeared to be the full extent to which makers were prepared to go. There is very little business passing in forge iron and prices are indeterminable. Lincolnshire basic is offered at £3 14s. to £3 15s. at furnaces.

Coke Values.

The fall in coke prices continues, much to the satisfaction of the Midand blast-furnacemen. On 'Change in Birmingham to-day ample supplies were available at 20s. per ton, and reports were current that business could be done at 17s. 6d. on rail. Those makers who were desirous of maintaining prices at the 22s. level fixed by the Association found themselves undercut by sellers who were willing to negotiate at below 20s. This break in prices has undoubtedly had the effect of stimulating buying. For some months past furnacemen have generally bought no more than the barest amount which prudence dictated, being well assured that unless coke came down there would be little profitable business to be done in pig iron. Moreover, during the past few weeks consumers watching the fall in North Country prices, had anticipated a similar development here, and had bought only as a last resource. They are now placing business more freely, but are acting with caution, considering the time not yet ripe to enter into forward commitments.

Steel.

The steel trade continues to be employed at a good rate, but new business is slow in developing, and plate mills in particular could do with more work. The call for structural material makes a heavy demand upon makers of joists and sections, but local contractors are experiencing a lull in the placing of new business, and they consider that many schemes are being held back pending more stable conditions in the market. Deliveries are much easier, and most descriptions of steel can be obtained in a reasonable period. Prices are unaltered officially, though some weakness is noticeable in certain descriptions. The trade in small steel bars is dull, and the price is in the neighbourhood of £8 10s. Some South Wales sellers of mild steel billets are offering supplies at a reduction of 5s. per ton on recent rates. Business is said to have been transacted this week at £6 15s. Most English mills adhere to the £7 quotation. Continental steel is being offered at very low prices, one quotation received this week for joists being £4 16s. 6d. Antwerp, or about £6 1s. 6d. delivered Birmingham. Competition amongst foreign makers for British business is very keen, and prices generally are at a low ebb. Billets cost about £5 7s. 6d. and sheet bars £5 10s.

Finished Iron.

Finished iron is receiving no increased attention. Where the home production is in competition with the imported article, the disparity in prices is so wide that a much greater change in makers' costs than now seems possible would be necessary to bridge the gap. There is a fair output of marked bars and the basis price of £14 10s. is maintained. Crown bars are quoted at £11 and by Lancashire houses at £11 2s. 6d. at port. Common iron, such as is used in the nut and bolt trade, can be purchased at £10 5s., as compared with £6 for Belgian iron. Wrought iron gas tube strip is in fair demand, values ranging from £12 10s. to £12 15s. per ton.

Galvanised Sheets.

Though home demand for galvanised sheets continues quiet, an improvement is reported in overseas requirements. Values are somewhat firmer, though there has been no change during the week in quotations. Galvanised corrugated sheets of 24 gauge command £14 15s. to £15. It was reported on 'Change in Birmingham to-day that an order had been placed for galvanised iron sheets, the higher price being regarded as justified by the increased resistance to corrosion. It is noteworthy that exports of sheets during April continued on the excellent lines of recent months. This may in some measure have been the result of the lowering of values which had for its special object the encouragement of overseas business.

Satisfactory Production.

Midland industrialists are pleased to learn that the excellent advance in pig iron production throughout the country continues, and that the splendid output achieved in March was surpassed last month. True there has been an increase of eleven in the number of furnaces in blast, bringing the total to 189, but that, under the present extremely difficult and trying conditions with demand notably poor, the output should have amounted to 680,000 tons, compared with 671,800 tons in March, and 539,100 tons in April, 1926, augurs well for output when conditions improve and an active demand exists. It is interesting to compare the production of the various kinds. Of the total 237,800 tons were hematite, 207,300 tons basic, 182,500 tons foundry and 22,600 tons forge. The production of steel ingots and castings last month is considered quite good, amounting as it did to 850,100 tons, compared with 949,600 tons in March. The decline was in a large measure due to the Easter holidays. The production in April, 1926, amounted to 661,000 tons.

Trade Returns.

It is gratifying to Midland iron and steel masters to learn that while imports of iron and steel were nearly £900,000 higher in value than in April last year, our exports of iron and steel goods were also greater in value by over £500,000, last month's export total being £5,674,713, against imports of £3,037,342. The total quantity of iron and steel imported during the month was 404,710 tons, compared with 261,787 tons in the corresponding month of last year. Taking the year to date, the imports show an advance on the corresponding period last year of no less than 911,182 tons.

Unemployment.

The re-absorption of labour into Midland industries continues at a rapid rate. Ever since the conclusion of the Easter vacation the unemployment returns for the area have steadily declined. The fall of 11,196 recorded in my last letter has been followed by one of 17,060, making a total decrease during the past fortnight of no less than 28,256. The total unemployed in the Midland area is now reduced to 131,560, to which the Birmingham area contributes 23,390. At Coventry the figures are down to 1764. The state of the heavy engineering industries in the Black Country, however, is shown by the fact that unemployment has actually increased during the past week iu the following areas:—Bilston, Cradley Heath, Wednesbury and Wolverhampton, though the total increase for all these towns only amounts to 273, of which the latter accounts for 179.

LANCASHIRE.

(From our own Correspondents.)

MANCHESTER.

Overseas Trade in Textile Machinery.

SHIPMENTS of textile machinery last month showed a remarkable falling off compared with those of March, not all of which is explained by the fact that April was a shorter working period, and that the incidence of the Easter holidays had a marked effect on the month's trading returns. The more obvious cause is the fact that exports of textile machinery to Russia—during the past eighteen months or so, one of the principal foreign markets for this class of plant—had dwindled almost to vanishing point. From being the most important, Russia was, in fact, last month easily the least important of the overseas buyers, the probable explanation being that the huge contracts for textile machinery placed in this country in 1925 are fast approaching completion. Shipments to all markets during April reached a value of £838,141, compared with £963,000 in the preceding month, and £835,997 in April of last year. Exports of spinning and twisting machinery during the period under review were valued at £599,489, and of weaving machinery at £177,668. The Russian market accounted for no more than £6440, against £132,569 in March, and £137,188 in April, 1926. Shipments to Japan were also on an appreciably smaller scale than in the previous month, amounting to £44,736, compared with £110,958, although the latter figure was unusually high. The falling off in the directions indicated was, in some measure, compensated by the increased value of the exports to the British East Indies, shipments thence amounting to £221,828, against £143,000 in March and £145,000 in the corresponding period of last year. Holland was the second largest market with £84,700, followed by France with £72,400, South America with £63,160, Germany with £59,800, the United States with £52,700, Japan with £44,700, Australia with £23,546, China with £14,270, Russia with £6440, and "other European countries" with £152,400.

Street Surfaces and Mud Splashing.

The Manchester Corporation Cleansing Committee this week has had before it for consideration the problem of road surface construction in relation to mud-splashing. The suggestion has been made that the formation of street surfaces in the city should be changed—that instead of the cambered surface from gutter to gutter the road should be divided into halves sloping towards the middle. The contention is that this would result in three distinct advantages:—(1) It would considerably modify the mud-splashing problem; (2) it would necessitate only one line of drainage pipes, down the centre, instead of one line at each side; and (3) surface refuse would gravitate to the middle and thus render cleaning easier. The suggestion is to be considered by the Paving Committee, although two strong grounds of objection have been expressed. The first is the extremely heavy cost of converting existing thoroughfares, and the second is that by sloping the streets inwards the roofs of tramcars will be brought dangerously close to one another, and it is pointed out that these vehicles occupy all the main thoroughfares where the chief benefit that would result from the adoption of the proposal—the diminution of mud-splashing—would be most appreciated.

Non-ferrous Metals.

Restricted operations in every section of the market for non-ferrous metals since my last report have had serious consequences from the point of view of prices. In the case of tin, lead and spelter, quotations at the time of writing are about as low as they have been this year, whilst so far as copper is concerned the current value is only fractionally better than the worst. Apart from a very modest trade demand for the metal during the greater part of the week, the tin market—usually extremely susceptible to outside influences—was seriously affected by

"bearish" American advices of depressing conditions. On balance cash metal at £290 15s. has lost about £7 since my last report, with forward positions at £283 5s. rather less than £5 down. The tone of the market at the moment is weak and the outlook far from certain. During the course of the week the cable-making industry has made fair purchases of wire rods in the copper market; but in spite of a fair aggregate turnover and favourable statistical advices from the United States, values have closed substantially lower than those of a week ago, probably to some extent in sympathy with the other metals. Lead has not received much support from consumers, and the result is reflected in current prices, which are now at an exceptionally low level. Spelter, too, has met with a limited demand, and here again a serious decline has taken place compared with a week ago.

Iron.

The most important feature of the pig iron market here, and the most interesting one from the point of view of the user, continues to be the pronounced weakness of the metal. A factor which must be exerting an influence is the relatively low rate at which foreign pig iron is being offered on this market, continental makers having just made a substantial "cut" in their selling prices. Formerly at about 85s. per ton, including delivery to buyers' works in the Manchester district, Dutch and Belgian iron is now being offered at 79s., a figure which leaves a pretty wide margin in favour of the imported iron even allowing for the latest reduction in Midland brands. Derbyshire makes have weakened to 85s. 6d., delivered Manchester, and Staffordshire to about 86s. Middlesbrough, however, is unchanged at 88s., with Scottish at 100s. and upwards, and East and West Coast hematites at 93s. A good many makers have still fair tonnages on their books for delivery against old contracts, and under these circumstances, with most big users still fairly well covered, there is little fresh inducement at present to place any further big orders. The result is that most of the current buying, as one maker described the position, is of a strictly retail character. Similar dull trading conditions prevail in the case of manufactured iron, although here, with prices down to about the pre-strike level, users have not the same grounds for complaint. The demand for bar iron is not more than sufficient to provide work for 50 or 60 per cent. of the productive capacity. Lancashire Crown bars are quoted at £11 per ton and seconds at £10.

Steel.

In the steel market, also, new business is on a disappointing scale, although specifications against the balance of existing contracts are said to be flowing fairly freely. In most instances, these old contracts are sufficient to meet the current needs of consumers, and even the constructional engineers, who are perhaps the busiest section of the engineering industry in this district, are placing little new business. Ship and tank plates are quoted at the basis price of £8 7s. 6d. per ton, joists and sections at £7 12s. 6d. to £7 15s., according to delivery, boiler plates at about £11 7s. 6d., and bars at £8 5s. to £8 17s. 6d. Except for the placing of orders for odd lots offers of continental steel are meeting with little response, and prices, on the whole, are weak. Imported joists and sections, for delivery to Lancashire works for cash against documents, are down to £5 17s. 6d., with ordinary plates quoted at £6 17s. 6d. to £7, Siemens plates at £7 5s., and Belgian bar iron at £5 12s. 6d. to £5 15s. Steel bars are rather steadier at £5 15s. to £5 17s. 6d., but billets and sheet bars are very dull and nominal at £5 to £5 2s. 6d. and £5 5s. to £5 7s. 6d. per ton. Continental wire rods are about unchanged at £6 7s. 6d. There is still a good demand for export to India for 24-gauge galvanised sheets, which, however, are back again to £14 12s. 6d. per ton f.o.b.

BARROW-IN-FURNESS.

Hematite.

Business is quiet in hematite pig iron. The recent cut in prices brought some business, but buyers generally are holding out for a further drop in iron prices, which is not quite so easy to bring about as it seems, although coke prices have been again easier. At present there is activity at the whole of the works in the area, and between the Carnforth and Workington districts there are sixteen furnaces in blast. For the most part the whole of the production is going into prompt use. Local steel makers are taking good deliveries. No charcoal iron is being made at present.

Iron Ore.

All through the mining areas there is activity, and a good output of metal is being maintained. The demand is almost wholly on local account for ordinary sorts, but some best grade ore is leaving the district. Importations of foreign ore are being made, cargoes reaching Barrow last week from Almeria and Kirkenes.

Steel.

In the steel trade there is quite a busy state of affairs at both Barrow and Workington, steel rails being the chief output. Orders are fairly well held, but new business is quiet all round. Deliveries are being made overseas. Hoops are a good trade, and the plant at Barrow is well employed, mostly on overseas orders.

Fuel.

There is a steady call for both coal and coke, most of the latter coming from the East Coast.

SHEFFIELD.

(From our own Correspondent.)

More Furnaces Stopped.

In referring to the continued absence of new business in the steel trade to take the place of the large accumulations of orders which have now been practically worked off, I have already had to record the fact that two of the large open-hearth furnaces at Templeborough have had to be stopped. Since I wrote last week a third furnace has been put out of commission there, as well as two more at other works. At the same time there are plants which are reported to be as busy as ever, and at the Penistone steel works, where five of the six furnaces are operating, it is stated that there are contracts in hand for some time to come. It is reported that new business is not coming through well for steel from the Lincolnshire centres. Conditions, therefore, are evidently of an up-and-down kind, and it is certain that they will remain so until the prices of pig iron and steel become stablised at, of course, a lower point than that now ruling. The Sheffield forges and rolling mills report that nearly all their customers are having difficulty in maintaining their position. The tire plant at Penistone, however, keeps fairly busy, and the rail rolling mills have good orders on hand. Trade in wire in Sheffield is brisk and some useful work for overseas is being executed. Conditions in the heavy foundry and engineering shops are depressing, orders having been scarce and most difficult to get for a considerable time. Business has fallen off recently in best tool steels, and increasingly severe foreign competition is noticeable.

Some Recent Contracts.

In face of severe continental competition, the Clayton Wagon Company, Ltd., of Lincoln, has secured a contract for the supply of twelve first-class articulated twin saloon coaches for the South African Government Railways. Other orders obtained by this firm recently include three "Clayton" railway steam cars for the Ceylon Government Railway, a "Clayton" railway steam car for the Aden Railways, and another for the Polish State Railways, two 200 H.P. light steam locomotives for the North-Western Railways of India, and a 200 H.P. light steam locomotive for the New Zealand Government Railways. The South African Railway Board has accepted the tender of the Midland Railway Carriage and Wagon Company, Ltd., of Birmingham, in which Cammell Laird and Co., Ltd., have a large interest, for thirteen coaches. This firm's tender amounted to £86,000, and that of the Clayton Wagon Company for the South African contract was for £80,000. Twenty-five tenders were received, including some from American and continental firms, but the British tenders were among the cheapest, and the firms were able to guarantee quicker delivery. The Stanton Ironworks Company, Ltd., has secured an order for the supply of 415 tons of 2in. to 8in. diameter cast and spun iron pipes, valued at £3969, for the Southwell Rural District Council. The Southport, Birkdale and West Lancashire Water Board, has accepted the tender of the Staveley Coal and Iron Company, Ltd., for about 700 tons of cast iron spigot and socket pipes and specials, 15in. in diameter.

Sheffield-Canadian Enterprise.

William Cooke and Co., Ltd., of the Tinsley Steel and Wire Rope Works, Sheffield, are establishing at Vancouver, Canada, plant for the manufacture of wire rope, suitable for the requirements of mining, shipping, agriculture, fishing and lumbering. I understand that it is the intention of the company to make in Canada rope from wire supplied from this country, so that the finished product will be of the same high standard as that produced at the Tinsley works.

Plate and Cutlery.

The plate and cutlery trades remain in a lifeless condition. Severe price cutting has been indulged in to get what business there is, and the trade generally is in an unsatisfactory state. A few Government contracts, and special contracts for catering concerns, together with what is fortunately a fairly good colonial market for good-class cutlery, comprise the bulk of the activity at the moment. Home trade through the shopkeeping channels is comparatively poor. The export returns for the first four months of the year show that the value of cutlery is down by about £10,000 on the figures for a year ago. Cutlery imports show a marked and steady increase.

Trade with Russia.

Sheffield has a very direct interest in the raid on the Arcos building in London, which caused such a sensation last week-end, for the city has had an important trade connection with Russia in tool steel, files, saws and other classes of tools. It is true that some Sheffield firms have declined to do business with Russia since the war, except on a cash basis, which, of course, was not forthcoming; but a number of firms which have had an important trading connection with that country have been accepting credit and doing business through the channel of Arcos. Such firms have been paying particular attention to the production of material of a kind suited for the Russian market, and work, varying in volume, has been carried out in the city from time to time. Considerable sums are owing to manufacturers for work done, and they are now naturally wondering what is going to happen as a result of recent events. Fresh orders were placed in Sheffield recently, and though it was stated that all of them had been cancelled, this is not so. I have heard of some at least that have not been cancelled.

Stanton Ironworks' Scheme.

Further particulars are available of the big reorganisation scheme that has been launched by the Stanton Ironworks Company, Ltd., the owners of the great pipe foundries near Nottingham. It is proposed to replace the nine old-type furnaces at Stanton Gate, having a weekly output of about 3500 tons of iron, by five of the most modern type, with a weekly output of 5000 tons. Of the original furnaces, four were at what are known as the old works, and five at the new works a short distance away. At the old works, where the furnaces have not been in blast for nearly two years, two new furnaces are to be erected. Work has already been commenced on these extensions by the contractors, Head, Wrightson and Co., Limited, Thornaby-on-Tees, and on one of the three at the new works. In the latter case progress will necessarily have to be slower, as four of the old furnaces are still in blast, and will, of course, not go out until the new plant is ready to be put into commission. It is expected that the furnace in course of construction at the new works will be ready by the end of this year, and those at the old works by March next year. The whole of the five furnaces in the full scheme will be of the same design, which is that of the company's own staff, embodying the most modern principles of blast-furnace practice. The furnaces will be mechanically charged with double-skip apparatus, have rotary tops, and be fed with trolley cars from a system of bunkers for the ore and limestone. Skips will be filled direct from bunkers for coke. The calcined stone will be brought from a system of new kilns which is being installed at the bunkers. There will be eight calcining kilns at the old works and probably twelve at the new works. The whole charging operation of each furnace will be undertaken by one man in place of ten men required with the existing type of furnace. The old plant at Stanton, by the way, was built about sixty years go.

New Sheffield Coking Plant.

It is, however, not only in the matter of blast-furnace practice that the great industrial areas of Yorkshire and the Midlands are adopting up-to-date plants. I have already recorded the decision of the Nunnery Colliery Company, Sheffield, to install a battery of twenty-five by-product coking ovens and other plant. The announcement is now made that the Tinsley Park Colliery Company, Sheffield, has decided to replace the whole of its older parallel-walled ovens by ovens of the latest taper construction, and for this purpose has placed an order for thirty ovens of the latest design with the Koppers Coke Oven Company, Ltd., Sheffield. Acting in conjunction with the Koppers Company, the Tinsley Park Company some time ago erected an experimental battery consisting of eight large-capacity taper ovens of the latest design, and it is the success of this experiment which has induced the company to scrap the rest of its older plant. In the experimental battery a charge of 9¼ tons of coal has been burnt off in 9½ hours, while regular working charges containing 10–12 per cent. moisture have been carbonised in 11–12 hours, which is equivalent to a throughput of 140 tons of coal per oven per week. The older ovens at Tinsley Park have a carbonising period of 30–32 hours, and hold a charge of 9¼ tons, this being equivalent to a throughput of 51½ tons of coal per oven per week. This new system of carbonisation can be operated so as to enable coke of a highly combustible nature to be produced which can be employed as a domestic fuel. One of the main ideas of the erection of the experimental plant was to provide means for carrying out tests on a working scale in order to ascertain whether the problem of smokeless fuel could be solved by the carbonisation of coal under high-temperature conditions. In order to enable these experiments to be effectually carried out, the plant has been equipped with machinery for the blending of several classes of coal in any desired proportion, for it has been found in many cases that a coke of an improved combustible character can be produced by the admixture of other coals. It is intended to continue to carry out exhaustive tests of this nature, and it is hoped that the results will prove of great value to the coking industry.

Colliery Developments.

Important developments are being carried out at Hatfield Main Colliery, which was recently taken over by the Carlton Main Colliery Company. A new slack washer is being constructed, and No. 2 shaft has been opened up to enable the Kent Thick seam, which is about 5ft. 9in. thick, to be worked. This seam is considered to be one of the finest in the district, and it is calculated that the output of the colliery will be doubled in twelve months.

Goole Docks Project.

An agreement has been arrived at between the Aire and Calder Navigation and Pease and Partners, Ltd., under which coal from the Thorne coalfield will be exported through the Goole docks instead of from a wharf which it was proposed to construct on the river bank below Goole. Under this new arrangement a railway will be constructed from Thorne to Goole across the Goole moors, and the coal will then be conveyed by high-level enclosed belt conveyers to loading appliances in the newly widened part of the Barge Docks, which is close to the site where more docks are to be built. Only appliances of the most modern type, such as will facilitate the quick loading of the ships, are to be utilised, and it is estimated that at the commencement they will be able to deal with 6000 tons of coal per week. Later, however, Pease and Partners will require accommodation to export some 600,000 tons per annum.

NORTH OF ENGLAND.

(From our own Correspondent.)

More Work for the North.

Prospects in the shipbuilding and heavy engineering trades are improved by the placing of more orders. The engine works department of W. G. Armstrong, Whitworth and Co., Ltd., Newcastle-on-Tyne, has received a contract from the London and North-Eastern Railway Company to take out and repair the three pairs of 90ft. entrance dock gates at Immingham Dock. R. and W. Hawthorn, Leslie and Co., Ltd., of Hebburn-on-Tyne, has booked an order for two vessels of about 8000 tons each for the Booth Line of Liverpool. The firm has also obtained a contract for two tugs for the Argentine Government, which is in addition to the order for two sloops which it received from the Argentine Government some time ago. Tyne firms which have tendered for work in connection with the Argentine Government naval programme are awaiting the placing of other contracts. It is reported that an order for two cruisers has been given to Italian shipbuilders, and if that is correct disappointment will be caused on the Tyne.

Cleveland Iron Trade.

The position in the Cleveland pig iron trade is very disappointing. Business is most difficult to negotiate, for foreign competition is keener than ever, and the general conviction that prices must fall further keeps many possible buyers off the market. Much improvement in demand is needed to assure continuity of full employment at the works. No doubt ironmasters will be reluctant to take such a step, but events may force their hands. Certainly, they are not selling anything like the quantity they are making, and it is not a commercial proposition to produce iron for stock. The root of the whole trouble is that prices are not down to a competitive level. Cleveland cannot approach continental prices, and any buyer prepared to use foreign iron can save several shillings per ton. There is still planty of imported iron coming into the Tees, and Scottish foundries are buying iron from Antwerp at about 10s. per ton less than Cleveland. Thus even another cut of 5s. per ton would not seem sufficient to shut out this imported iron, which is killing Cleveland industry. Cleveland makers, however, refuse to make further concessions, and maintain the following as their minimum:—No. 1 foundry, 77s. 6d.; No. 3 G.M.B., 75s.; No. 4 foundry, 74s.; No. 4 forge, 73s. 6d.

Hematite Pig Iron.

In the East Coast hematite pig iron trade prices are still drooping. This week 80s. per ton is the recognised market quotation for mixed numbers, but that is for small lots, and were a good order to come along even better terms could be obtained. But nearly all the business done is for very small lots, and export orders are very scarce owing to the competition of cheap German hematite.

Ironmaking Materials.

Iron ore imports continue on a heavy scale, but there is a less confident note regarding forward business owing to the uncertainty of the iron trade outlook. Best Rubio ore, however, remains steady at 22s. per ton c.i.f. Tees. The fuel market is in a deplorable state, but it does not raise hopes of cheaper coke for the furnaces. For good medium furnace qualities delivered at the works 22s. 6d. per ton is a full price, and probably 22s. could be done.

Manufactured Iron and Steel.

The steel works are still working at full capacity and exports are heavy, but manufacturers are becoming apprehensive about the continued dearth of new orders. The plate mills are not nearly so busy as they have been, and both plates and sections are realising 5s. per ton less than was the case a few weeks ago. Other quotations remain unchanged.

The Coal Trade.

The Northern coal trade is passing through another difficult time. Owing to the lack of business large numbers of miners in Durham County have received notices. Several pits are only working three days a week, and some may have to close altogether if trade does not revive. Only one section of the market exhibits any movement, and that is Northumberland steam coals, which continue in fairly heavy demand for prompt delivery. For other classes of fuel there is little business passing, and the outlook is not encouraging. The first half of the year is now well advanced, and the much-needed expansion of trade to keep the pits employed regularly does not come. Collieries producing the best qualities of steam coal could take on much more business if it were offered. There is sufficient trade, however, to keep values very steady, and direct sellers ask 14s. 6d. to 14s. 9d. Second-hand holders are indicating similar figures in view of the inquiries for prompt cargoes. Lower grades are also moving off a little better, and smalls maintain their recent firmness, as they are in lessened output. Durham steams, both large and small, are very steady at late prices. Gas coal pits are working on old contracts, and fresh orders are coming along very slowly. Best Durham gas qualities are quoted at from 16s. 6d. to 17s. 6d., but firm business submitted to sellers could probably shade these quotations. Coking coals and bunkers are dull for all directions. Coke is in large supply, and values are steady, though consumers are purchasing very cautiously in the hope of prices coming down. Best gas coke is about 20s. 6d., patent foundry and beehive foundry 23s., and special makes 26s. to 28s.

SCOTLAND.

(From our own Correspondent.)

Dull Outlook.

MOST departments of the steel and iron trades in this district are largely affected by the continued dullness. Some branches have plenty of work on hand at present, but the absence of new business is causing some anxiety. Conditions may show an early improvement, but meantime consumers are not taking as much material as manufacturers would like. There is evidently little doubt that shipbuilding firms and other concerns have a considerable amount of business to place, but at present conditions are unusually slow, and the outlook, prior to the holiday season at least, is discouraging.

Diesel Engines: New Glasgow Works.

Fiat British Auxiliaries, Ltd., has made arrangements to open works in Glasgow, which will be devoted to the manufacture of auxiliary Diesel engines of the Fiat type for marine purposes, and auxiliary and main engines for land purposes. Machinery up to 1500 B.H.P. will be made. The site of the works extends to about 6½ acres, and manufacturing operations will be commenced as soon as the necessary plant is installed.

Steel.

Most of the steel works are still busy, bringing deliveries up to date. Sections and plates are urgently wanted for work in progress. New orders, however, are not coming forward as expected, and unless some speeding up takes place a few weeks will find many works in need of specifications. Steel prices are unaltered, but any transactions going through at present have to be concluded at Association prices, which are somewhat below those obtainable a short time ago.

Steel Sheets.

The demand for most grades of steel sheets has apparently fallen off, and prices show a weakening tendency.

Bar Iron.

The bar iron works are working under adverse conditions. Home demands are far below expectations, and any business being done for export entails a sacrifice in prices. Similar conditions rule in the re-rolling departments. Re-rolled steel bars are in the region of £8 2s. 6d. per ton for home delivery.

Scrap.

Heavy scrap material is firm in price at present, owing, it is said, to a pronounced shortage, owing to buying operations abroad. Cast iron scrap is, however, easier.

Iron Ore.

Imports of iron ore at Glasgow during the past week totalled upwards of 10,000 tons. During the same period the imports of iron were unusually small.

Coal.

The Scottish coal market continues without change. Outputs have been still further reduced, but are equal to all demands. The tendency is weak in all districts, with treble nuts providing the only exception to the general rule. Most collieries are averse to a further shading of prices, and as a rule concessions are only given when a clearance at the pit is desired. The demand for home consumption is poor, buying being of a strictly hand-to-mouth variety, while foreign business is difficult to negotiate. Aggregate shipments amounted to 242,110 tons, against 274,168 tons in the preceding week and 209,395 tons in the same week last year.

WALES AND ADJOINING COUNTIES.

(From our own Correspondent.)

The Trade Outlook.

THE conditions prevailing in this district are far from satisfactory, and the outlook leaves much to be desired. It must be acknowledged that so far as the steam coal trade is concerned, shipments have been relatively active. There has been a steady expansion, and yet the conditions existing are very disappointing. Business is very slow, and all indications point to a very dull time being experienced during the next month or so at least. This may appear to be very conflicting, but there is no doubt that the shipments that have been in progress and are now being carried out are based on business effected some little time ago, and, furthermore, it is more than likely that the eight-hour day with its increased production is being felt. The demand from abroad is insufficient to absorb the existing output and, as a consequence, the market is easy. Still this district has had a very fair run and it is not surprising that there should be some reaction, as, for several months past, the prices prevailing for Welsh coals have been relatively high when set against the figures at which North Country coals have been obtainable. Quite apart from the current demand being negligible, there is not much being done in the contract line. The Central Brazilian Railway is reported to have bought 100,000 tons of Welsh coals, consisting of two-thirds large and one-third small, for delivery from May to August, and the Portuguese State Railways have purchased about 16,000 tons, but up to the time of writing the Norte railways of Spain, which were in the market for about 12,000 tons of steam coals recently, but called for fresh tenders, have not actually bought. The Navagazione Generale Italiana has also contracted for about 55,000 tons of best Welsh large coals for shipment over June–September, but all these orders put together do not amount to much when extended over a period. So far as shipping is concerned, it is interesting to note that two local companies have returned to a dividend-paying basis after a period of about three years, but those shipowners whose tonnage is on the small side and is employed in the short trades, are experiencing a most difficult time. The rates of freight prevailing in the French Coast and Bay trades are quite unremunerative, and it is surprising that so many owners can keep their steamers running. The conditions in the tin-plate trade leave much room for improvement, and further works have temporarily suspended operations, though in the ship-repairing trade employment is still fairly good but not up to the standard of the past month or so.

Miners and their Wages.

It is doubtful whether there is anyone who would claim that the miners are earning good money, and yet there are grave fears that from the end of this month there will be a reduction in their earnings. The 1926 agreement provides that the wages for June, July and August shall be the 1915 standard base rates plus a percentage to be determined in accordance with the results of the industry in February to April, subject to a minimum of 28 per cent. added to such standard rates. The ascertainment for the period from February to April is expected to be shortly made known, and will be the first since the resumption of work in the coalfield following upon the national strike of last year. So far as can be ascertained, there is the distinct probability that the percentage addition to the 1915 standard rates will be reduced from 42·22 per cent. to the minimum of 28 per cent., and also of the subsistence wage, which now stands at 8s. 0½d. per shift, being lowered, but the latter is a question that will be fully considered at a meeting of the South Wales Coal Conciliation Board, which is to be held on the 31st inst.

Docks Traffic.

The returns of the Great Western Railway Company relating to the six docks under its control in South Wales show that, for the four weeks ending April 17th last, imports amounted to 454,770 tons, as against 496,120 tons for the four previous weeks, and 430,400 tons for the corresponding period of last year. Exports totalled 2,772,601 tons, compared with 2,672,882 tons in the preceding four weeks and with 2,380,325 tons for the corresponding period of 1926. Taking the figures from January 1st to April 17th last, imports came to 1,821,824 tons, as against 1,600,087 tons, while exports totalled 9,587,837 tons, compared with 9,778,224 tons for the corresponding period of last year. Imports and exports combined, therefore, amounted to 11,409,661 tons, as against 11,378,311 tons, so that up to April 17th last trade was on the right side, although the margin of improvement is somewhat narrow.

Ship-repairing Industry.

Further progress has been made in coming to agreement for a revision of the working conditions in the ship-repairing industry of this district, thus enhancing the chances of employers competing more successfully for work in the near future. Last week it was announced that the negotiations between the employers and the representatives of the Amalgamated Engineering Union had been brought to a satisfactory conclusion, and that throughout them the best of feeling had prevailed. The revised rules have to be submitted to constituent members of both parties, as the terms arrived at have been arranged at a joint conference of their representatives. The workers concerned in this agreement are the fitters, turners, blacksmiths, patternmakers, millwrights and machinists.

Current Business.

The tone of the steam coal market has become very quiet during the past week, and the amount of business now being done is almost a shadow of normal times. Many collieries are working very irregularly, and are experiencing the greatest difficulty in maintaining recent prices. One or two of the best kinds of Admiralty large coals are well placed for the next week or two, but second Admiralty large coals are distinctly uneven, while some of the Monmouthshire qualities are in poor demand pits have been idle. Best Admiralty large coals are nominally quoted at 22s. 6d. to 23s., but it is doubtful whether these figures are obtainable. Small coals are steady for the reason that the interrupted working of collieries is interfering with the output of smalls. Patent fuel is relatively a very steady market, and works are comparatively well off for the remainder of this month. Pitwood is easy for prompt supplies, and the irregular working at pits is prejudically affecting the demand for this commodity, which is quoted at 29s. to 30s.

PERSONAL AND BUSINESS ANNOUNCEMENTS.

AUTOMATIC AND ELECTRIC FURNACES, Limited, of 173-175, Farringdon-road, London, E.C. 1, asks us to announce that an arrangement has been entered into between it and Messrs. Carlo Brivio, of Via Principe Umberto, 25, Milan, for the manufacture and sale of Wild-Barfield electro-magnetic furnaces in Italy.

THE MIRRLEES WATSON COMPANY, Ltd., Glasgow, asks us to announce that it has acquired the rights of manufacture and sale, both for land and marine service, for the British Empire, of the surface condenser made in France by La Société des Condenseurs Delas of Paris, with power to grant sub-licences to other condenser manufacturers. This condenser embodies the patented inventions of Engineer-Admiral Ginabat, late of the French Navy, and Monsieur Delas of Paris.

MESSRS. COUZENS AND BROWN, of 9, Old Queen-street, Westminster, S.W. 1, ask us to announce that, consequent upon the death of Captain Reginald J. Wallis-Jones, the sole surviving partner of the firm of Wallis-Jones and Dent, consulting engineers, of 50, Queen Anne's-gate, London, S.W. 1, they have taken over the business of that firm. All works and other engineering matters now in progress which were previously under the supervision of Wallis-Jones and Dent will be attended to by them, and it is requested that all correspondence relating to such works should in future be addressed to themselves.

LAUNCHES AND TRIAL TRIPS.

TORONDOC, steamer; built by Swan, Hunter and Wigham Richardson, Ltd., to the order of Paterson Steamships, Ltd., of Canada; dimensions, 253ft. long. Engines, inverted marine type with three cranks; constructed by the builders; launch, April 14th.

IRIONA, steamer; built by Workman, Clark and Co., Ltd., to the order of the United Fruit Company, of Boston; dimensions, 355ft. by 48ft. by 31ft. 6in.; 4200 gross tonnage. Engines, direct-acting, inverted four-cylinder triple-expansion; constructed by the builders; launch, April 21st.

VALLEY CAMP, steamer; built by Swan, Hunter and Wigham Richardson, Ltd., to the order of the Valley Camp Coal Company, Ltd., of Ontario; dimensions, 260ft. by 43ft. beam; 2000 tons deadweight. Engines, triple-expansion; constructed by the builders; trial trip, April 22nd.

ARABISTAN, single-screw steamer; built by William Gray and Co., Ltd.; to the order of Frank C. Strick and Co., Ltd.; dimensions, 400ft. by 53ft. 6in. by 29ft. 7¼in. Engines, triple-expansion, 28in., 46in. and 77in. diameter by 48in. stroke, pressure 180 lb.; constructed by the builders; trial trip, April 25th.

HVOSLEF, steamer; built by Swan, Hunter and Wigham Richardson, Ltd; to the order of A/S "Flora," Oslo, Norway; dimensions, 254ft. 6in. by 35ft. 6in. wide. Engines, triple-expansion; constructed by the builders; trial trip, April 26th.

Current Prices for Metals and Fuels.

IRON ORE.

N.W. COAST—	
Native	18/6 to 21/-
(1) Spanish	18/6 to 21/-
(1) N. African	18/6 to 21/-
N.E. COAST—	
Native	18/- to 21/-
Foreign (c.i.f.)	22/-

PIG IRON.

	Home. £ s. d.	Export. £ s. d.
(2) SCOTLAND—		
Hematite	4 5 0	
No. 1 Foundry	4 9 0	—
No. 3 Foundry	4 4 0	—
N.E. COAST—		
Hematite Mixed Nos.	4 0 0	4 0 0
No. 1	4 0 6	4 0 6
Cleveland—		
No. 1	3 17 6	3 17 6
Silicious Iron	3 17 6	3 17 6
No. 3 G.M.B.	3 15 0	3 15 0
No. 4 Foundry	3 14 0	3 14 0
No. 4 Forge	3 13 6	3 13 6
Mottled	3 13 0	3 13 0
White	3 13 0	3 13 0
MIDLANDS—		
(3) Staffs.—		
All-mine (Cold Blast)	—	—
North Staffs. Forge	3 12 6	—
,, ,, Foundry	4 1 6	—
(3) Northampton—		
Foundry No. 3	3 15 0	—
Foundry Forge	3 8 0	—
(3) Derbyshire—		
No. 3 Foundry	3 17 6	—
Forge	3 12 6	—
(3) Lincolnshire—		
No. 3 Foundry	4 0 0	—
No. 4 Forge	—	—
Basic	3 17 6	—
(4) N.W. COAST—		
N. Lancs. and Cum.—		
Hematite Mixed Nos.	4 15 6 (a); 4 18 6 (b); 5 2 0 (c)	—

MANUFACTURED IRON.

	Home. £ s. d.	Export. £ s. d.
SCOTLAND—		
Crown Bars	11 5 0	41 0 0
Best	—	—
N.E. COAST—		
Iron Rivets	12 5 0	—
Common Bars	11 15 0	—
Best Bars	12 5 0	—
LANCS.—		
Crown Bars	11 0 0	—
Second Quality Bars	10 0 0	—
Hoops	14 0 0	—
S. YORKS.—		
Crown Bars	11 10 0	—
Best Bars	12 5 0	—
Hoops	14 0 0	—
MIDLANDS—		
Crown Bars	11 5 0	—
Marked Bars (Staffs.)	14 10 0	—
Nut and Bolt Bars	10 5 0	—
Gas Tube Strip	12 10 0 to 12 15 0	

STEEL.

	(6) Home. £ s. d.	(7) Export. £ s. d.
(5) SCOTLAND—		
Boiler Plates	11 0 0	11 0 0
Ship Plates, ¼in. and up	8 2 6 to 8 5 0	£8 0 0 to 8 2 6
Sections	7 12 6 to 7 15 0	£7 10 0 to 7 12 6
Steel Sheets, under 3/16 in. to ¼in.	10 0 0 to 12 0 0	
Sheets (Gal. Cor. 24 B.G.)	—	£15 0 0 to 16 0 0

STEEL (*continued*).

	Home. £ s. d.	Export. £ s. d.
N.E. COAST—		
Ship Plates	8 2 6	—
Angles	7 12 6	—
Boiler Plates	12 10 0	—
Joists	7 12 6	—
Heavy Rails	8 10 0	—
Fish-plates	12 0 0	—
Channels	10 5 0	£9 to £9 5
Hard Billets	8 12 6	—
Soft Billets	7 12 6	—
N.W. COAST—		
BARROW—		
Heavy Rails	8 10 0	—
Light Rails	8 15 0 to 9 0 0	
Billets	8 0 0 to 11 10 0	
MANCHESTER—		
Bars (Round)	8 17 6	—
,, (Small Round)	8 5 0	—
Hoops (Baling)	11 0 0	11 0 0
,, (Soft Steel)	10 15 0	10 15 0
Plates	8 7 6	—
,, (Lancs. Boiler)	11 7 6	—
SHEFFIELD—		
Siemens Acid Billets	11 0 0	—
Hard Basic	9 2 6	—
Intermediate Basic	8 12 6	—
Soft Basic	7 5 0 to 7 10 0	
Hoops	12 0 0	—
Soft Wire Rods	9 5 0	—
MIDLANDS—		
Small Rolled Bars	8 10 0 to 8 15 0	
Billets and Sheet Bars	6 15 0 to 7 0 0	
Sheets (20 W.G.)	11 10 0 to 12 0 0	
Galv. Sheets, f.o.b. L'pool	14 15 0 to 15 0 0	
Angles	7 15 0 to 7 17 6	
Joists	7 15 0 to 7 17 6	
Tees	8 15 0 to 8 17 6	
Bridge and Tank Plates	8 7 6	—
Boiler Plates	11 0 0 to 11 10 0	

NON-FERROUS METALS.

SWANSEA—	
Tin-plates, I.C., 20 by 14	19/3 to 19/6
Block Tin (cash)	290 15 0
,, (three months)	283 5 0
Copper (cash)	54 8 9
,, (three months)	55 1 3
Spanish Lead (cash)	24 17 6
,, (three months)	25 7 6
Spelter (cash)	28 17 6
,, (three months)	28 8 9
MANCHESTER—	
Copper, Best Selected Ingots	60 15 0
,, Electrolytic	61 10 0
,, Strong Sheets	86 0 0
,, Tubes (Basis Price) lb.	0 1 0½
Brass Tubes (Basis Price) lb.	0 0 11½
,, Condenser lb.	0 1 1½
Lead, English	26 7 6
,, Foreign	25 12 6
Spelter	29 2 6
Aluminium (per ton)	£107

FERRO ALLOYS.

(All prices now nominal.)

	Per Ton.	Per Unit.
Tungsten Metal Powder	1/10 per lb.	
Ferro Tungsten	1/5 per lb.	
Ferro Chrome, 4 p.c. to 6 p.c. carbon	£23 10 0	7/6
,, ,, 6 p.c. to 8 p.c. ,,	£22 15 0	7/3
,, ,, 8 p.c. to 10 p.c. ,,	£22 7 6	6/6
,, ,, Specially Refined		
,, ,,Max. 2 p.c. carbon	£36 5 0	11/6
,, ,, ,, 1 p.c. ,,	£42 5 0	15/-
,, ,, ,, 0.70 p.c. carbon	£54 0 0	17/6
,, ,, ,, carbon free	1/5d. per lb.	
Metallic Chromium	3/3 per lb.	
Ferro Manganese (per ton)	£16 for home, £16 for export	
,, Silicon, 45 p.c. to 50 p.c.	£11 12 6 scale 5/- per unit	
,, ,, 75 p.c.	£19 0 0 scale 6/- per unit	
,, Vanadium	14/3 per lb.	
,, Molybdenum	5/- per lb.	
,, Titanium (carbon free)	0/11½ per lb.	
Nickel (per ton)	£170	
Cobalt	9/3 per lb.	

FUELS.

SCOTLAND.

(Prices not stable.)

	Export.
LANARKSHIRE—	
(f.o.b. Glasgow)—Steam	14/-
,, ,, Ell	14/6
,, ,, Splint	15/6 to 16/9
,, ,, Trebles	14/- to 14/3
,, ,, Doubles	13/- to 13/6
,, ,, Singles	12/9
AYRSHIRE—	
(f.o.b. Ports)—Steam	13/9
,, ,, Jewel	15/6
,, ,, Trebles	14/6
FIFESHIRE—	
(f.o.b. Methil or Burntisland)—Steam	12/6 to 14/-
Screened Navigation	18/- to 19/-
Trebles	14/6 to 15/3
Doubles	13/3
Singles	13/-
LOTHIANS—	
(f.o.b. Leith)—Best Steam	13/9
Secondary Steam	13/- to 13/3
Trebles	14/9
Doubles	13/3 to 13/6
Singles	13/-

ENGLAND.

	Export.
(8) N.W. COAST—	
Steams	27/6
Household	42/6 to 58/6
Coke	28/6 to 29/-
NORTHUMBERLAND—	
Best Steams	14/6 to 14/9
Second Steams	13/9 to 14/-
Steam Smalls	10/6
Unscreened	13/6 to 13/9
Household	21/- to 27/-
DURHAM—	
Best Gas	16/6 to 17/6
Second	14/9 to 15/3
Household	21/- to 27/-
Foundry Coke	23/6 to 26/6

SHEFFIELD—	Inland.	
Best Hand-picked Branch	30/- to 31/-	
Best Selected House Coal	25/- to 27/6	—
Screened House Coal	22/- to 24/-	—
,, ,, Nuts	18/6 to 20/6	—
Yorkshire Hards	18/- to 20/-	—
Derbyshire Hards	18/- to 20/-	—
Rough Slacks	10/6 to 11/6	—
Nutty Slacks	8/- to 9/-	—
Smalls	3/- to 5/6	—
Blast-furnace Coke (Inland)	22/- to 27/6 at ovens.*	
,, ,, (Export)	f.o.b.	26/- to 27/-

(9) SOUTH WALES.

CARDIFF—	
Steam Coals:	
Best Smokeless Large	22/6 to 23/-
Second ,, ,,	21/- to 22/-
Best Dry Large	20/6 to 21/6
Ordinary Dry Large	19/- to 19/6
Best Black Vein Large	21/- to 21/6
Western Valley Large	19/6 to 20/-
Best Eastern Valley Large	19/- to 19/6
Ordinary ,, ,,	18/6 to 19/-
Best Steam Smalls	14/3 to 14/9
Ordinary Smalls	12/- to 14/-
Washed Nuts	18/- to 22/-
No. 3 Rhondda Large	23/- to 24/-
,, ,, Smalls	16/6 to 17/-
No. 2 ,, Large	19/6 to 20/6
,, ,, Through	17/6 to 18/6
,, ,, Smalls	13/- to 14/-
Foundry Coke (export)	40/- to 45/-
Furnace Coke (export)	30/- to 32/6
Patent Fuel	25/6 to 26/6
Pitwood (ex ship)	29/6 to 30/6
SWANSEA—	
Anthracite Coals:	
Best Big Vein Large	41/- to 45/-
Seconds	32/6 to 37/6
Red Vein	27/- to 30/-
Machine-made Cobbles	45/- to 50/-
Nuts	45/- to 47/6
Beans	35/- to 37/6
Peas	20/- to 22/-
Breaker Duff	9/- to 9/9
Rubbly Culm	11/6 to 12/-
Steam Coals:	
Large	21/- to 22/-
Seconds	19/- to 21/-
Smalls	11/6 to 12/6
Cargo Through	16/6 to 17/6

(1) Delivered. (2) Net Makers' works. (3) f.o.t. Makers' works, approximate. (4) Delivered Sheffield. (5) Glasgow, Lanarkshire and Ayrshire.

(6) Home Prices—All delivered Glasgow Station. Boiler Plates 10/- extra delivered England. (7) Export Prices—f.o.b. Glasgow. (8) Except where otherwise indicated, coals are per ton at pit for inland and f.o.b. for export, and coke is per ton on rail at ovens and f.o.b. for export. (9) Per ton f.o.b. (a) Delivered Glasgow. (b) Delivered Sheffield. (c) Delivered Birmingham. * Open market price. Special price for pig iron producers, 22/- per ton at ovens.

French Engineering Notes.

(From our Correspondent in Paris.)

Production and Prices.

WHEN the franc ceased its erratic fluctuations and manufacturers began to suffer from the effects of a stabilisation, they bore their losses with equanimity in the belief that business would soon adapt itself to the new money values. The franc has remained at its present level a sufficiently long time to allow of such an adjustment taking place, and yet there is no improvement in business and no promise of renewed buying. The situation has not changed, and there is now very little hope of much being done this year, apart from the orders that are being given out for railway and shipbuilding material. There is just enough employment to prevent many works from closing down. The main cause of this want of activity is the increased prices of commodities, which were expected to come down with the higher value of the franc, but have been advanced by the heavy taxation and by the difficulty of reducing wages so long as the cost of living remains at its present level. The meagre home consumption of iron and steel is reflected in the prices, which have been steadily weakening for some time past; but mill and forge owners now find that they have, in many cases, got below their minimum limit, and declare that unless they can sell steel at profitable rates they will reduce production still further. Another disturbing factor in the situation is the debate now taking place on the new Tariff Bill. No one knows what the effect of the Bill will be, although there are many who are alarmed at the possible consequences of retaliation, and it is evident that there can be no normal adjustment of business until it is seen in what form the Bill will be finally passed. So far it is noteworthy that the Government and the Commission of Customs have suffered a check through being obliged to accept an amendment partially exempting from duties the materials required for shipbuilding, such as plates and boilers.

The Coal Trade.

The efforts that were made to increase the coal output at the time of the British miners' strike are having more serious consequences than could have been anticipated. Seeing that the production is only about 60 per cent. of the home requirements, it was expected that French coalowners would have no difficulty in disposing of all the coal they could bring to bank; but the geographical situation of the collieries, to say nothing of the quality of much of the coal produced, makes it impossible to compete with British coal in parts of the country where low freights permit of its being sold at below the prices the French can afford to accept. It does not appear as if the efforts to favour French coal, by according it special preferential railway rates, will meet with much success, although it will certainly have some effect upon the prices of British coal, and it is remarkable that during the preliminary debate upon the Tariff Bill the proposed import duty of 5 per cent. *ad valorem* on anthracite had to be withdrawn. It is replaced by the duty of 20 centimes per 100 kilos. That is not encouraging for the French colliery industry, which has been clamouring for protection as the only means of saving it from disaster, and the agitation is now gathering in force in view of the attempts which are now being made by coalowners to reduce wages still further. It is affirmed that in the Nord and the Pas de Calais the stocks of coal amount to a million and a-half tons. The men are informed that unless they accept another reduction in wages they will have to work fewer hours. Both the owners and men are to meet the Minister of Public Works to discuss the situation, with the idea, apparently, of introducing new arguments into the debate on the Tariff Bill.

Motor Car Industry.

The condition of the motor car industry can obviously only be improved by an entire reorganisation, and it is believed that that will entail the disappearance of a number of small firms. The object in view is to consolidate the position of the big makers by means of an amalgamation of interests, whereby costs will be reduced and the commercial services simplified, but that is presenting many difficulties, and it is only by force of circumstances that the organisation will be possible. Except in one or two cases, it does not seem as if much export business is being done in cars, and in view of the uncertain future with regard to foreign trade, it is hoped to develop considerably the trade in cars at home. The number of cars running in France is relatively small compared with that in some other countries, particularly taking into account the importance of the industry. The new methods being adopted for the sale of cars prove that makers are keenly alive to the necessity of creating a bigger demand at home. Another instance of the difficulty of the situation is the failure, so far, to retrieve the business of De Dion-Bouton. One of the latest combinations was proposed by a Franco-German group, which offered to refloat the business on condition that the construction of the cars should be carried on as before, but with engines imported from Germany. The import duties provided by the new Tariff Bill put this combination out of the question, and the negotiations fell through.

Mont Valerien Lighthouse.

Although the lighthouse on Mont Valerien, on the outskirts of Paris, has been working intermittently for a month past, it is not regarded yet as being in service, but it is now beginning to flash nightly and the service will very soon become regular and uninterrupted. The idea of installing an exceptionally powerful light on the fort began to take definite form during the war, and after the construction of the lighthouse on Mont Afrique, near Dijon, for the guidance of airmen between the Channel and the Mediterranean, it was decided to push forward with the installation on Mont Valerien, which was to be the most powerful of its kind in the world. There are two mirrors, each 2 m. in diameter, with arc lamps operating with 300 ampères. It is stated that in exceptionally fine weather a pilot at Croydon would see the light from a height of 1000 m. The mirrors revolve and flash the light every eight seconds.

British Patent Specifications.

When an invention is communicated from abroad the name and address of the communicator are printed in italics.

When an abridgment is not illustrated the Specification is without drawings.

Copies of Specifications may be obtained at the Patent Office, Sale Branch, 25, Southampton-buildings, Chancery-lane, W.C., at 1s. each.

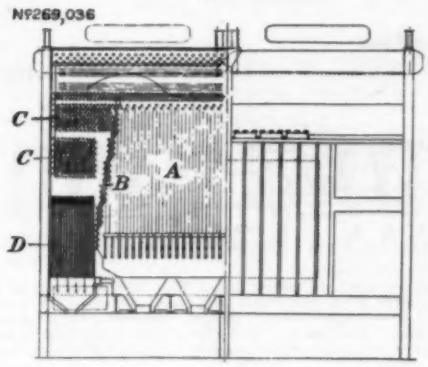
The date first given is the date of application; the second date, at the end of the abridgment, is the date of the acceptance of the complete Specification.

STEAM GENERATORS.

269,036. August 9th, 1925.—WATER-TUBE BOILERS, *Babcock and Wilcox, Ltd., Farringdon-street, London, E.C.* 4.

The object of this invention is to reduce the height of the combustion chamber of a water-tube boiler burning powdered fuel. On either side of the combustion chamber A there are arranged

Nº269,036



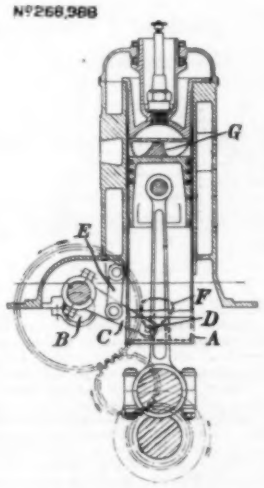
water tubes B in such a fashion as to form a complete wall. Between this wall and the casing there is space for part of the steam generating tubes C C and for an air heater D. The path of the furnace gases is up the centre of the combustion chamber and down the side passes.—*April 14th*, 1927.

INTERNAL COMBUSTION ENGINES.

268,988. May 17th, 1926.—SLEEVE VALVE MECHANISM, P. Burt, Hollybank, Bothwell, Lanarkshire.

This valve gear is more or less of the Argyle type, that is to say, the sleeve both reciprocates and oscillates. The sleeve A is driven by the lay shaft B by means of the crank and link C.

Nº268,988



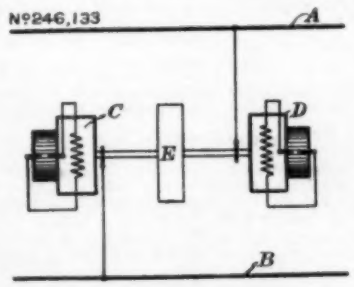
The link is connected with the sleeve by a universal joint D and is hung on the link E. The resultant path of movement of a point on the sleeve is indicated by the dotted line F, and the shape of the ports is correspondingly formed, as shown at G.—*April 14th*, 1927.

DYNAMOS AND MOTORS.

246,133. January 8th, 1926.—IMPROVEMENTS IN OR RELATING TO ROTARY ELECTRIC TRANSFORMERS FOR COUPLING TWO ALTERNATING-CURRENT NETWORKS, Siemens Schuckertwerke Gesellschaft mit beschrankter Haftung, of Berlin-Siemensstadt, Germany.

The coupling of two alternating-current circuits of fluctuating

Nº246,133

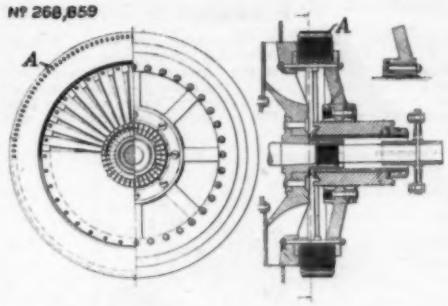


or different frequency offers difficulty. According to this invention, the circuits A and B are connected together by a converter consisting of two three-phase shunt machines C and D, connected to the circuits A and B as shown. On the converter shaft there is a fly-wheel E. If this fly-wheel is brought into action, say, by a transfer of energy from the circuit A to the circuit B, the speed characteristic of the machine C, acting as a generator, must be regulated to make it give up a greater amount of energy. The generator thus puts a greater load on the shaft, that is to say, exercises a breaking action which brings the fly-wheel into action and gives a buffer action. For altering the speed-load characteristic suitable regulating devices are provided.—*April 8th*, 1927.

268,859. January 4th, 1926.—IMPROVEMENTS IN ARMATURES OF ELECTRO-MOTORS AND GENERATORS, Frederick William Lanchester, Dyott End, Oxford-road, Moseley, Birmingham, and Lanchester's Laboratories, Ltd., of 38, Bailey-lane, Coventry.

Armatures constructed in accordance with this invention are capable of running at higher peripheral speeds than usual.

Nº 268,859



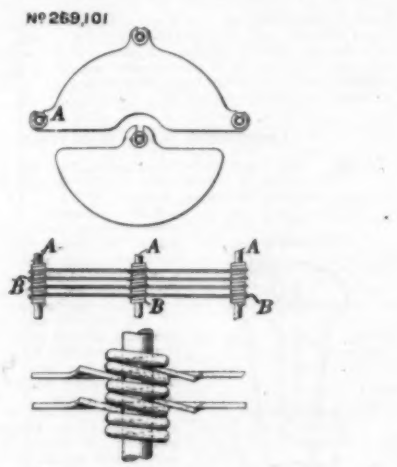
The armature is of the gramme type, with perforated laminations for the reception of the conductors A. The return connection is taken as a single layer through the interior of the ring or through perforations. The support for the armature consists of two plates. The right-hand illustration is a longitudinal section of the armature, which is more or less self-explanatory.—*April 4th*, 1927.

TELEGRAPHS AND TELEPHONES.

269,101. December 11th, 1926.—IMPROVEMENTS IN AND RELATING TO ELECTRIC CONDENSERS, *The British Thomson-Houston Company, Ltd., of Crown House, Aldwych, London, W.C.* 2.

An electrical condenser constructed in accordance with this invention can be easily formed, and assembled with a minimum amount of material and labour. The stationary plates are held in position by bolts A, around which are coiled springs B, and

Nº 269,101

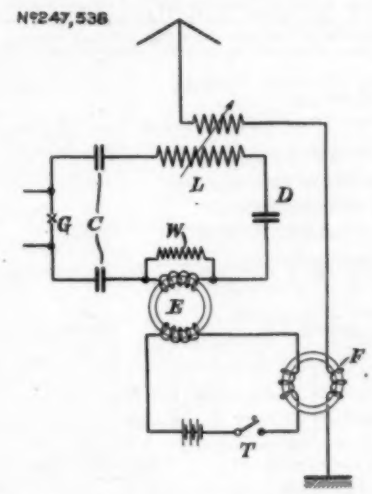


between the convolutions of these springs the plates are inserted, each plate being provided with a set of holes corresponding to the bolts. The parts of the plates that are inserted between the convolutions of the springs are warped into helical form, so that they may be properly received between the spring convolutions. This construction, most clearly shown by the lower illustration, which shows a portion of the rotor.—*April 14th*, 1927.

247,538. January 19th, 1926.—IMPROVEMENTS IN OR RELATING TO HIGH-FREQUENCY RADIO TRANSMISSION SYSTEMS, C. Lorenz Aktiengesellschaft, of Lorenzweg, Berlin-Tempelhof, Germany.

This invention relates to high-frequency radio transmission

Nº247,538



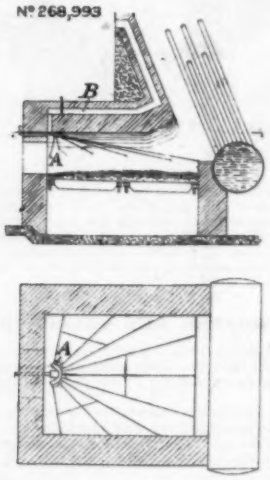
systems of the type in which there are one or more intermediate circuits between the circuit containing the high-frequency generator and the aerial, and has for its object the equalisation

of the load on the high-frequency generator during operation of the transmitting key. In the system illustrated, a high-frequency generator G, such as an arc generator, for example, is connected to an intermediate circuit comprising condensers C, a coupled tuning coil L in the aerial circuit, a tuning condenser D and the primary coil of a choking device E, the transmitting key T being in a controlling circuit connected with the aerial circuit by a choking device F. A resistance W is connected in parallel with the primary coil of the choking device E, and the conditions are such that when the key T is closed, both the choking devices are saturated, so that there is no choking effect, but when the key is open the choking devices are not saturated and energy from the generator G passes through the resistance W. By suitably proportioning this resistance the load on the generator may be maintained uniform whether the key T be closed or open, the choking device E acting as a relay for the resistance W. —*April 4th*, 1927.

FURNACES.

268,993. May 25th, 1926.—FURNACES FOR STEAM BOILERS, *F. G. Brettell, 75, Colmore-row, Birmingham.*

This boiler furnace is of the "Dutch oven" type; that is to say, it is wholly exterior to the heating surface. Its peculiarity lies in the fact that it is provided with a steam jet apparatus A near the roof. The jets are so contrived that those



issuing towards the sides of the furnace are more powerful than those directed straight forward—see the plan view. The result, it is claimed, is that the furnace gases are prevented from flowing up the side walls of the furnace and are constrained to go forward, while they are intimately mixed with the secondary air admitted by the passage B.—*April 14th*, 1927.

LIGHTING AND HEATING.

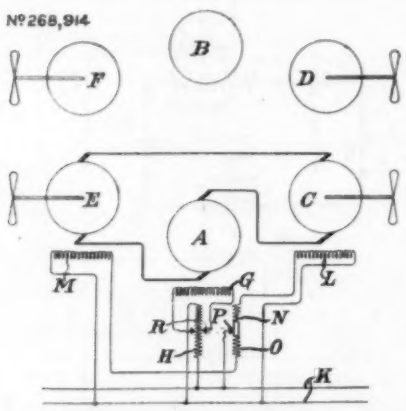
268,986. May 14th, 1926.—IMPROVEMENTS IN OR RELATING TO ELECTRIC INCANDESCENT LAMPS, *Harold Wade, of* 111 *and* 112, *Hatton-garden, London, E.C.* 1.

This invention is concerned with electric incandescent lamps, which, in order that the light absorption may be decreased, have a substance introduced into them that possesses the property of converting the tungsten volatilised off the filament into a form that does not absorb light, and which is usually referred to as a "getter." A method has been found by the inventors which permits of manufacturing lamps in which the "getter" action can be accurately regulated in accordance with the quantity of tungsten that is volatilised. As shown in the illustration, the lamp is provided with an auxiliary electrode A, which is coated with a "getter," and which, under the influence of an electrical discharge between the auxiliary electrode and the filament, is capable of generating a gas that forms with the volatilised material of the filament a transparent compound.—*April 14th*, 1927.

SHIPS AND BOATS.

268,914. February 1st, 1926.—IMPROVEMENTS IN AND RELATING TO SYSTEMS OF ELECTRIC SHIP PROPULSION, The British Thomson-Houston Company, Ltd., of Crown House, Aldwych, London, W.C. 2, and Alan Adair Pollock, of Croxton House, Sherbourne-place, Leamington Spa, Warwick.

In the case of ships fitted with propellers fore and aft, it is

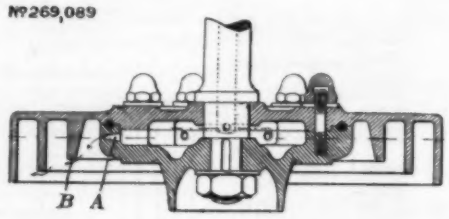


desirable from the point of view of efficiency to run the forward propeller at a lower speed than the aft propeller. According to this invention, this is accomplished by connecting the forward and aft motors in series, and also in series with the generator and providing controlling arrangements, as shown. A and B are the generators, C and D the forward motors and E and F the aft motors. The generator A is connected in series with the forward motor C and the aft motor E and its field G is excited through a potentiometer rheostat H of a Ward-Leonard controller, from a separate constant voltage excitation supply K. The field windings L and M are connected in parallel across the excitation supply and their circuits are connected with biassing or balancing resistances N and O in such a manner that if the sliding contact P on the controller be moved upwards, the field winding M will be weakened and the winding L strengthened and *vice versâ*. The contact P is connected to a sliding contact R on the potentiometer rheostat H, so that it moves with it. The method of operating the arrangement is fully described.—*April 14th*, 1927.

MISCELLANEOUS.

269,089. November 23rd, 1926.—ATOMISERS FOR LIQUIDS, F. E. Martin, 21, Calle Princesa, Barcelona, Spain.

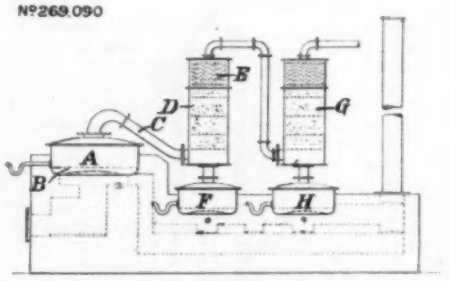
This atomiser is said to be specially applicable to the spraying of sulphuric acid within leaden chambers, and is of the centrifugal type. The whole of the device shown in the illustration is rotated at a considerable speed, and the liquid to be atomised is



introduced down the hollow shaft. The liquid is driven out of the orifices A by centrifugal force, and is atomised to some extent by impingment on the skirt B. Any liquid which escapes atomisation is impelled over the lower edge of the skirt B, and strikes the next skirt, and so on until it is fully atomised.—*April 14th*, 1927.

269,090. November 23rd, 1926.—FRACTIONAL DISTILLATION, Thermal Industrial and Chemical (T.I.C.) Research Company, Ltd., Allington House, Victoria-street, London, S.W. 1, and W. J. Chadder.

In this process tar is introduced into the primary still A, which may be heated by any suitable means; for instance, it may contain a layer of molten metal B. In this still the tar is completely distilled in such a way that a molten residue, pitch, alone remains. This may be removed from the still as or when desired. The evolved vapours escape through the conduit C into the fractionator D, consisting of a vessel, the lower portion of which is charged with a suitable material providing as large a surface as possible, for the purpose of scrubbing these vapours by means of the condensed liquor descending from the dephlegmator E which occupies the upper part of the vessel. The condensate



from the dephlegmator having passed through the scrubbing material flows into the secondary still F, which contains molten metal and is heated by any suitable means; for instance, by waste gas from the primary still A. This still is kept at a temperature slightly below that of the boiling point of the constituents which it is desired to separate, that is slightly below the temperature existing in the dephlegmator. This will cause any lighter boiling constituent contaminating the desired fraction to become re-evaporated with the result that the partial vapour pressure of this lighter boiling constituent in the scrubbing chamber of the fractionator D will be increased, which will facilitate the removal of these lighter constituents. The vapours leave the top of the dephlegmator and are led into the bottom of the second scrubbing tower G, which communicates with the tertiary still H, and so on.—*April 14th*, 1927.

Forthcoming Engagements.

Secretaries of Institutions, Societies, &c., desirous of having notices of meetings inserted in this column, are requested to note that, in order to make sure of its insertion, the necessary information should reach this office on, or before, the morning of the Wednesday of the week preceding the meetings. In all cases the TIME *and* PLACE *at which the meeting is to be held should be clearly stated.*

TO-DAY.

ROYAL INSTITUTION.—21, Albemarle-street, W. 1. Discourse, "Structure of the Silicates," by Professor W. L. Bragg. 9 p.m.

SATURDAY, MAY 21ST.

INSTITUTE OF BRITISH FOUNDRYMEN: LANCASHIRE BRANCH.—Visit of the Junior Section to the works at Ashton-under-Lyne of the National Gas Engine Company, Ltd. Parties will commence to tour the works at 2.45 p.m.

INSTITUTION OF MUNICIPAL AND COUNTY ENGINEERS.—North-Eastern District Meeting at Berwick-on-Tweed, to inspect the New Bridge. 2.30 p.m.

TUESDAY, MAY 24TH.

JUNIOR INSTITUTION OF ENGINEERS.—Visit to the Showrooms of Holophane, Ltd., Westminster, and lecture and demonstrations, "Stage and Colour Lighting," at 7 o'clock.

WEDNESDAY, MAY 25TH.

INCORPORATED RADIO SOCIETY OF GREAT BRITAIN.—At Institution of Electrical Engineers, Savoy-place, W.C. 2. "The Hot Wire Microphone and Audio Resonant Selection," by Mr. G. G. Blake. 6 p.m.

THURSDAY, MAY 26TH.

INSTITUTION OF MUNICIPAL AND COUNTY ENGINEERS.—Town Hall, Ilkeston. East Midland District meeting. 10.45 a.m.

FRIDAY, MAY 27TH.

INSTITUTION OF PRODUCTION ENGINEERS.—Council Room, Society of Motor Manufacturers and Traders, Ltd., 83, Pall Mall, S.W. 1. "Rate Fixing," by Mr. J. Ronald. 7.30 p.m.

ROYAL INSTITUTION, 21, Albemarle-street, W. 1. Discourse, "Gabriel Y. Galan, Contemporary Spanish Poet," His Excellency the Marquis de Merry del Val. 9 p.m.

FRIDAY AND SATURDAY, MAY 27TH AND 28TH.

INSTITUTION OF MUNICIPAL AND COUNTY ENGINEERS.—Town Hall, Newport, South Wales District Meeting. 10.45 a.m. and 9.30 a.m. respectively.

SATURDAY, MAY 28TH.

JUNIOR INSTITUTION OF ENGINEERS.—Visit to the Shell Haven Installation of Shell-Mex, Ltd. 1 p.m.

THURSDAY, FRIDAY AND SATURDAY, JUNE 2ND TO 4TH.

THE INSTITUTION OF MUNICIPAL AND COUNTY ENGINEERS.—Scottish District meeting at Dunfermline.

SATURDAY, JUNE 4TH.

INSTITUTION OF MUNICIPAL AND COUNTY ENGINEERS.—South-Eastern District meeting at Maidstone.

TUESDAY, JUNE 28TH.

INSTITUTION OF MUNICIPAL AND COUNTY ENGINEERS.—Visit to the Kent Cement Works at Greenhithe by steamer, which will start from Westminster Bridge Pier at 10 a.m.

CONTRACTS.

THE FULLER ACCUMULATOR COMPANY (1926), Ltd., Chadwell Heath, Essex, has received an order from the India Store Department for 26,775 inert dry cells. The same Company has also received an order for its TD 17 type train lighting cells, in wood lead-lined containers, from the Crown Agents for the Colonies.

THE GENERAL ELECTRIC COMPANY, Ltd., of Magnet House, Kingsway, London, W.C. 2, has received an order from the General Post Office, London, for 75,000 Robertson carbon filament telephone switchboard lamps; and from the Turton Urban District Council for twelve months' supply of Osram metal filament vacuum lamps.

SIR W. G. ARMSTRONG, WHITWORTH AND CO., Ltd., inform us that their engine works department has received an order from the London and North-Eastern Railway to take out and repair the three pairs of 90ft. entrance lock gates at Immingham Dock. The gates will be floated out and towed up the Humber about 9¼ miles to the slipway at the Dockyard, Hull, where the repairs will be carried out.

TURBINE PUMPS FOR SHANGHAI.—Holden and Brooke, Ltd., wish us to state that the efficiency obtained with the 10-stage turbine pump illustrated and described in last week's issue of THE ENGINEER was as high as 76 per cent.

BRITISH OPTICAL SCIENCE.—The scientific work accomplished at the Optical Convention, which was held in London last year, has proved to be of great interest and importance. It is recorded in the "Proceedings" of the Convention, two volumes which run to over a thousand pages. These volumes contain many original papers of exceptional interest in all branches of optics. Inquiries with regard to the Convention and its publications should be addressed to the secretary, the Optical Convention, 1926, 1, Lowther Gardens, Exhibition-road, London, S.W. 7.

STORING DRAWINGS FOR REFERENCE.—The Plan-Clip Company, of 4, St. Paul's Churchyard, London, E.C. 4, has sent to us some literature concerning a system of filing, or storage, of blue-prints, and other large sheets, for which several claims to excellence are made. The essence of the idea lies in hanging the prints, vertically, in bunches held by specially-designed wire clips from a horizontal hanger, which may be attached to any convenient support. Hangers have been evolved for fixing on the wall, on the edge of a table, and on floor standards. Alternatively the prints may be hung up in special cabinets or cupboards.

STONE PRESERVATION.—In December, 1922, the Department of Scientific and Industrial Research set up the Stone Preservation Committee to consider the best methods by which decay, especially in ancient structures, may be prevented or arrested. A report on the progress of the Committee's work has now been published. The Committee found that it was first necessary, for the prosecution of its work, to arrange for a thorough investigation of the various types of decay in relation to the character of the stone and the climatic and industrial local conditions. Broadly speaking, the study has two aspects:—(*a*) Chemical, physical and geological; and (*b*) biological. Copies of the report may be obtained from any branch of His Majesty's Stationery Office, price 1s. 3d. net.

MILD *versus* HIGH TENSILE STEEL IN REINFORCED CONCRETE.—A booklet containing a reprint of correspondence between Mr. H. Weston and the Ministry of Transport regarding the relative value of mild steel and high tensile steel in reinforced concrete construction has been issued by the Weston Concrete Engineering Company, Ltd., of the Metropolitan Steel Works, West Norwood. The correspondence deals with a clause which is incorporated in the specification issued by the Ministry of Transport for the special trunk roads which are now being undertaken. The clause in question differentiates between high tensile and mild steel, and allows 6·66 lb. of high tensile steel as the equivalent of 10 lb. of mild steel. Mr. Weston contends that both types of steel are mutually equivalent in so far as the design of reinforced concrete structures is concerned and that it is impossible to supply 10 lb. of mild steel as the equivalent of 6·66 lb. of high tensile steel by reason of the greater value of the mild steel as based on the relative qualities and weights fixed by the specification. Reports from Messrs. David Kirkaldy and Son, Dr. Oscar Faber, D.Sc., M. Inst. C.E., and the Considère Constructions, Ltd., are submitted in support of Mr. Weston's contentions. According to the testimony of Mr. G. Topham Forrest, F.R.I.B.A., superintending architect to the London County Council, it appears that his Council has never permitted a lesser sectional area of steel reinforcement to be used in the case of high tensile steel than would be required if mild steel were employed, and, moreover, that the steel reinforcement must, in any event, comply with the British Standard Specification for structural steel for bridges and general building construction. The booklet may be obtained from the Weston Concrete Engineering Company, Ltd.